SCIENCE

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CONTENTS:

The Van't Hoff Celebration: PROFESSOR HARRY C. JONES 241
The Meeting of Naturalists at Chicago: PROFESSOR C. B. DAVENPORT 246
Some of the Problems of Limnology: PROFESSOR E. A. BIRGE 253
A Preliminary Account of some of the Results of the Plankton Work of the Illinois Biological Station: PROFESSOR C. A. KOFOID 255
Malaria and Tuberculosis 258
Scientific Books:—
Tarde's Social Laws: PROFESSOR LESTER F. WARD. *Von Ihering's die Conchylien der patagonischen Formation:* DR. J. B. HATCHER. *Geological Survey of Canada:* DR. H. M. AMI. *MacBride on North American Slime Moulds:* PROFESSOR GEORGE F. ATKINSON 260
Societies and Academies:—
Section of Biology of the New York Academy of Sciences: PROFESSOR FRANCIS E. LLOYD 269
Discussion and Correspondence:—
Do the Reactions of the Lower Animals against Injury indicate Pain Sensations?: DR. G. V. N. DEARBORN. *Plant Material for Laboratory Use in the Schools.* PROFESSOR GEO. F. ATKINSON .. 270
Do Fishes Remember?: DR. EDWARD THORNDIKE 273
The German Consular Service 274
Education in the United States 274
Education Administration in the State of New York .. 275
Indian University for Research 276
Scientific Notes and News 276
University and Educational News 280

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THE VAN'T HOFF CELEBRATION.

A QUARTER of a century has passed since Van't Hoff obtained the degree of Doctor of Philosophy. This event was celebrated on December 22, 1899, in Rotterdam, by his students and a number of guests, including some of the leading men of science. An extra volume of the *Zeitschrift für physikalische Chemie*, containing investigations by those who, at some time, had worked with Van't Hoff, was published and presented to him on this occasion.

What does this mean; why has such an unusual tribute been paid to this comparatively young man?

There is nothing more inspiring to workers in the field of science, than the lives and works of those who are the leaders of modern science. Let us turn to the biographical sketch of Van't Hoff, by Ostwald, which serves as a preface to the 'Jubelband.'

Van't Hoff is the son of a Dutch physician, and was born in Rotterdam, August 30, 1852. He received his early training at a high school in his native city, and at seventeen entered the Polytechnic Institute in Delft. He then studied at Leiden, with Kekulé at Bonn, and with Würtz in Paris. He made the doctor's degree at the University of Utrecht, on the 22d of December, 1874. In 1876 he became docent at the veterinary school in Utrecht, and in 1877 was called to the University in Amsterdam. In 1894

he left Amsterdam to accept a chair of Physical Chemistry at the University of Berlin, which had been founded especially for him.

Van't Hoff's contributions to science fall into three classes; or we may say, in brief, he has done three things. His earliest work of importance had to do with the spatial arrangement of the atoms in the molecule. In the same year in which he obtained the degree of Doctor of Philosophy, he published a small pamphlet of eleven pages, which is the beginning of all stereochemistry. In the following year it was enlarged to forty-four pages, and published in French under the title, "La chimie dans l'espace." It was translated into German two years later, with an enthusiastic preface by Wislicenus.

The attitude of Kolbe, who utilized his position to belittle not only the work but also its author, is familiar to every one. Indeed, so familiar, that Kolbe's reputation for liberality is not materially increased by the criticism which he offered of this work.

Van't Hoff attempted, in this work, to formulate a rational theory of the arrangement of the atoms in the molecules of certain substances. Let us consider the very simple compound of carbon and hydrogen, CH_4. All the properties of this substance show that it is a symmetrical compound, every hydrogen atom bearing exactly the same relation to the molecule. By what possible geometrical configuration in three dimensions can this be expressed? Evidently by the regular tetrahedron, and by this alone. If we represent the carbon atom as being placed at the center of a regular tetrahedron, and the four hydrogen atoms at the four corners, or in the four solid angles of the tetrahedron, we have a perfectly symmetrical configuration. This was pointed out by Van't Hoff, and has come to be known as the 'theory of the tetrahedral carbon atom.'

One application of this theory will serve to show how it has been of service in advancing our knowledge of organic substance. A comparatively large number of compounds were known, which, in the liquid state or in solution, would rotate the plane of polarization when a beam of polarized light was passed through them. In some cases the rotation was to the right, in other cases to the left. Further, it was very probable that for every substance which rotates the plane of polarization in one direction, there is a substance of the same composition rotating the plane in the opposite direction. How could these facts be interpreted in terms of the theory of the tetrahedral carbon atom?

Van't Hoff pointed out that every one of these so-called optically active substances contains a carbon atom in combination with *four different atoms or groups.* It is only when the four atoms or groups at the solid angles of the tetrahedron are all different, that two configurations are possible. If any two of the atoms or groups are the same, it is impossible to construct two tetrahedra which shall differ from one another. But if the four atoms or groups are all different, two tetrahedra can be constructed which bear the relation to each other of an object and its image in a mirror. These two configurations represent the two substances which have the same composition, but are optically active in opposite senses. When this theory of 'the asymmetric carbon atom' is applied to all of the facts known concerning optically active substances, we find that out of the seven hundred optically active compounds, there is only *one* which may be an exception to it. But this substance is so complex that its constitution is far from settled.

This is but one application of the theory of the tetrahedral carbon atom. This theory has thrown entirely new light on the meaning of isomerism in organic chemistry. By

means of it many cases of isomerism have been satisfactorily explained, whose meaning was entirely shrouded in darkness before the theory was proposed. By means of this theory large numbers of isomeric substances have been predicted, and many of these have already been discovered.

The theory of the space relations in carbon compounds has led directly to a theory of the stereochemistry of compounds containing nitrogen, and some extremely interesting and important work has been done in the last ten years upon this problem. Under the guidance of these new conceptions entirely new classes of compounds have been brought to light, and cases of isomerism discovered whose existence could never have been suspected, had not the theory of the tetrahedral carbon atom been proposed.

If we look over the field of organic chemistry in a broad way, it is not too much to say that the most important advances which have been made in organic chemistry in the last quarter of a century, have centered closely around this theory of the tetrahedral carbon atom. If we think only of the applications of the theory which have been made by Wislicenus, Hantzsch, and Emil Fischer, we shall see that it has contributed more to the advancement of our knowledge in this field, than any suggestion since Kekulé proposed the benzene hypothesis which bears his name.

In 1878 Van't Hoff published a book which is but little known, and which has had but little direct influence—'Ansichten über die organische Chemie.' But this book is closely connected with his second great contribution to chemistry.

He attempted to develop a side of organic chemistry which had hitherto received but very little attention. What would be the effect of different masses of one substance when allowed to act on a given mass of another substance? This quantitative side of organic chemistry had been either entirely neglected, or dealt with only as affecting the yield which would result from the reaction. Van't Hoff applied the law of Guldberg and Waage to organic reactions, and pointed out the importance of the study of the dynamics of reactions. He studied the velocity with which given reactions would take place, and the conditions under which equilibria in chemical processes were established. His first results were published in his 'Études de Dynamique Chimique' in 1884.

The work is not simply experimental. Indeed its theoretical side is of the very highest importance, since it was shown here that we can apply thermodynamics to chemical processes. The whole science of chemical dynamics and statics has acquired an entirely new meaning in the light of this work, which has contributed more to place organic chemistry on a quantitative basis, than any investigation which has ever been published. This work was greatly enlarged and published in 1896, under the title 'Studien zur chemischen Dynamik,' by Van't Hoff and Cohen.

The second epoch-making work of Van't Hoff is much less widely known than the first. This is due in part to the comparative complexity of the processes dealt with, and in part to the rigorous mathematical treatment which he applied to them. But I believe that time will show that the *Chemical Dynamics* of Van't Hoff is vastly more important than his *Stereo-chemistry* in placing chemistry upon that exact mathematical basis, toward which all branches of natural science tend, as our knowledge of the phenomena becomes deeper and deeper.

The third great work of Van't Hoff still remains to be considered. I refer to the relation which he showed to exist between the pressure of gases and the osmotic pressure of solutions. The genesis of this idea has been furnished us by Van't Hoff him-

self, in the lecture which he was invited to deliver before the German Chemical Society in 1894. As we have seen, he was early occupied with the study of the position of atoms in space. From this he was led to study the velocity of reactions and the conditions of equilibrium in chemical processes. But the problem of affinity was closely connected with that of equilibrium. As an example of affinity he studied the attraction of salts for their water of crystallization. He found this to be very small and adds: "I had the impression that even the weakest chemical forces are very large. * * * The question arose whether it is not possible, in simpler cases, to measure the attraction for water more directly; and for this purpose the aqueous solution is the simplest conceivable—much simpler than the compound containing water of crystallization. Coming from the laboratory with this question in mind, I meet my colleague De Vries, and his wife. He was just at that time carrying out osmotic investigations, and he told me about Pfeffer's determinations."

Van't Hoff was thus introduced to the work of Pfeffer, in which the latter had measured the osmotic pressure exerted by aqueous solutions of a number of substances, when separated from the pure solvent by a semipermeable membrane, through which the solvent, but not the dissolved substance, could pass. Van't Hoff observed from Pfeffer's results, that the osmotic pressure exerted by any substance at a constant temperature is proportional to the concentration of the solution, and saw in this an analogy to Boyle's law for gas-pressure. The gas-pressure of a gas is proportional to the concentration of the gas. Having found this one relation between osmotic pressure and gas-pressure, he tested other laws of gas-pressure by the osmotic pressure of solutions, and found that the law of Gay Lussac for the temperature coefficient of gas-pressure, applies also to the temperature coefficient of osmotic pressure. These two laws of gas-pressure might apply to the osmotic pressure of solutions, and still the absolute value of the two pressures be very different.

The fundamental question still remains: Is there any close relation between the actual pressure exerted by a gas, and the osmotic pressure exerted by a solution containing the same number of dissolved particles in a given space as there are gas particles; temperature, of course, being the same in the two cases? Van't Hoff discovered this remarkable fact; that the gas-pressure exerted by a gas particle is *exactly equal* to the osmotic pressure exerted by a dissolved particle, concentration and temperature being the same in the two cases; space playing a rôle with gases, which is analogous to that of the solvent with solutions. In a word, Avogadro's law for gases applies directly to the osmotic pressure of solutions. The three fundamental laws of gas-pressure thus apply directly to the osmotic pressure of solutions.

This relation is, in itself, of course very interesting. But why is it referred to as of epoch-making importance? Partly because of the new light which it throws on the whole problem of solution. We can apply thermodynamics freely to gases, and since the laws of gases apply to solutions, we can use thermodynamics in dealing with solutions in the same sense as in dealing with gases. And partly because it is the forerunner of the most important theory which has been proposed in chemistry or in physical chemistry for the last half-century.

We have stated that the laws of gas-pressure apply to the osmotic pressure of solutions, and this is true for solutions of certain classes of substances. It holds for all of those substances which, when in solution, do not conduct the current and therefore do not undergo decomposition. These

substances are called non-electrolytes. But this relation does not hold for any substance which, when dissolved in water, conducts the current; and this class, called the electrolytes, includes all the acids, all the bases and all the salts. The exceptions to Van't Hoff's generalization are quite as numerous as the cases which conform to it; and the former are even more interesting than the latter.

To account for these exceptions it was assumed that in aqueous solutions of acids, bases and salts, the molecules are more or less broken down or dissociated into ions; the amount of the dissociation increasing with the dilution of the solution. An ion is an atom, or group of atoms, charged either positively or negatively. This suggestion, which has been placed upon its present quantitative bases by Arrhenius, is the direct outcome of the analogy between the laws of gas-pressure and of osmotic pressure, pointed out by Van't Hoff. The theory of electrolytic dissociation thus originated.

The importance of the discovery of the applicability of the gas laws to osmotic pressure can now be seen, when we consider that this relation, together with its direct consequence, the theory of electrolytic dissociation, are the two corner-stones of modern physical chemistry. Indeed, the physical chemistry of to-day has grown up almost entirely around these two conceptions. It is from these two generalizations, directly, that Nernst has calculated the electromotive force of primary cells, and has furnished us with the first satisfactory theory of the action of such cells. Still further, he has gone into the cell itself and analyzed its action, calculating the amount of potential which exists at the several sources of potential, and has shown that molecules as such have nothing to do with the action of the primary element; only the ions into which the molecules dissociate coming into play.

These generalizations have, on the other hand, entirely revolutionized our conception of chemical activity. We now know that a large majority of the chemical reactions with which we have to deal, take place entirely between ions; atoms and molecules as such, playing no rôle whatsoever in the reaction. Indeed, we have already reached a stage where it is safe to say that very few chemical reactions are other than ionic; and very recent work makes it more than probable that atoms and molecules are entirely incapable of entering into any chemical reaction. The chemistry of atoms and molecules is thus rapidly giving place to the chemistry of ions. But space will not allow further applications of these all-important generalizations.

In addition to these three monumental pieces of work, any one of which would secure permanent fame for its author, Van't Hoff has made a number of important contributions to science. His paper on *Solid Solutions* has called attention to an interesting and important class of phenomena, which had never been in any sense connected with solutions. And the activity which characterized the earlier years of his life still manifests itself to an unusual degree. This is seen in the number and nature of the investigations which are coming from his laboratory in Berlin, and in the volumes which are appearing from his pen.

If we take into account the nature and significance of the entire work of this remarkable man, it seems quite safe to predict that he will be regarded in the future as occupying a place in the same rank with men like Pasteur and Virchow, Helmholtz and Kelvin.

The celebration in Rotterdam in honor of the first twenty-five years during which Van't Hoff has worked for pure science, is a memorable event especially in the history of modern physical chemistry. There were

present such men as Ostwald, Roozeboom, Lobry de Bruyn, Spring, Lorenz, Goldschmidt, Du Bois, Bredig, Ikeda, Dawson, De Hemptinne, Holleman, Jorissen, Reicher, Var Laar, Wind, Cohen, Meyerhoffer, and many others; including a large number of his students and friends.

The Burgermeister of Rotterdam made an address of welcome, which was followed by a second address by Ostwald. Telegrams were received from all parts of Europe, and cablegrams from America, Japan and Java; extending congratulations to Van't Hoff. Cohen, who was for a long time Van't Hoff's assistant in Amsterdam, prepared and presented to Van't Hoff a biographical sketch of the life of the latter, while Meyerhoffer presented the 'Jubelband.'

A word in conclusion in reference to this volume. Some two years ago a printed slip was sent to all who had worked with Van't Hoff, inviting them to contribute an original investigation to a volume which would be published and presented to Van't Hoff on the twenty-fifth anniversary of the day on which he received his degree of Doctor of Philosophy. A short time before the volume was published we were notified that it would appear as an extra volume of the *Zeitschrift für physikalische Chemie.*

It has thus appeared as volume 31 of this Journal and is known as the 'Jubelband für J. H. Van't Hoff.' Outside of its personal interest to those who have sent contributions, and of its scientific value, it has a linguistic interest. It contains papers in four languages: German, English, French, and Dutch. The papers are evidently published in the languages in which they were written by the contributors. The volume contains twenty-six papers in all, most of them from Germany and Holland, but there are a few from England and two from America.

Thus was celebrated the first quarter of a century of activity of this most brilliant man. The history of men of science has few such records.

Harry C. Jones.

Chemical Laboratory,
Johns Hopkins University,
February 2, 1900.

THE MEETING OF NATURALISTS AT CHICAGO.

In response to a call issued December 8, 1899, and signed by Professors C. R. Barnes, H. H. Donaldson, S. A. Forbes, W. A. Locy and Jacob Reighard, about thirty naturalists of the Central States met at the Hull Biological Laboratory, on Thursday and Friday, December 28th and 29th. Among those present, in addition to the Chicago naturalists, were Professors Burrill, Kofoid and Smith, of the University of Illinois; J. G. Needham, of Lake Forest; H. V. Neal; of Knox College; Birge, of Wisconsin; Lee, Nachtrieb and Sigerfoos, of Minnesota; H. L. Osborne, of Hamline University; Nutting, of Iowa; Eigenmann, of Indiana and Reighard and Jennings, of Michigan. Professor Donaldson presided at all the meetings and at the dinner.

Thursday morning and Friday morning and afternoon were devoted to the reading of papers. Twenty-five titles were announced; but five of these were omitted through the absence of the naturalists who announced them or through lack of time. Thursday afternoon was devoted to a discussion on 'Methods and Results of Limnological Work.' Professors Birge and Kofoid opened the discussion, in which Professors Reighard, Nachtrieb, Eigenmann, Osborn and Davenport also took part. The papers of Professors Birge and Kofoid follow this report. On Thursday evening a dinner was held at the Quadrangle Club, and was attended by thirty persons. After the dinner the question of organization was considered. Since the American Society of Naturalists simultaneously meeting at New Haven had neither rejected nor adopted the

proposition that a branch or section of the American Naturalists should be authorized to hold meetings in the Central States, but had appointed a committee to consider the matter, it was decided not to organize. A committee consisting of Professors Rieghard, Locy and Nachtrieb was instructed to nominate five naturalists who should have charge of all arrangements for a second meeting and should report at that meeting recommendations for a permanent organization and for the establishment of relations with the American Society of Naturalists. The committee subsequently elected consists of Professors Birge, President; Barnes, Lee, Nutting and Davenport, Secretary.

Abstracts of the papers read at the meeting follow:

Townet collecting at Cold Spring Harbor, Long Island. CHAS. P. SIGERFOOS.

During the summers of 1898–99 fairly complete records of townet collecting were kept at the Laboratory of the Brooklyn Institute. Cold Spring Harbor is so far from the open sea that larval and other transitory pelagic forms are never, perhaps, swept in by winds and tides from the outside. This is an advantage in many cases, because it enables the collector to say that certain forms found there live, thrive and breed locally.

As elsewhere, the day collections are less varied and abundant than those made in the night-time. In the former are present the medusæ of various hydroids (*Podocoryne*, *Bougainvillea*, *Perigonimus*, *Obelia*, etc.); ctenophores (*Mnemiopsis*) in all stages; starfish larvæ; pelagic fish eggs; and many other forms found less frequently or especially at night. In the night-time there are present, in addition to the above, great numbers of copepods (mostly of a species of *Acartia*), many of its individuals parasitized by *Apoblema;* larvæ, in various stages, of *Squilla*, decapods and other crustaceans; adult *Diastylus*, *Mysis*, *Gammarus*, etc.; the larvæ of various molluscs (*Ostrea*, *Crepidula*, *Bulla*); and many other forms found less frequently. One of the most interesting finds consisted of a few specimens of tornaria larvæ, apparently belonging to an undescribed species of *Balanoglossus* found at Cold Spring Harbor.

On the motor reactions of Flagellata and Ciliata. H. S. JENNINGS.

Previous work had shown that the aggregations of Paramecia in certain chemicals, in regions of optimum temperature and the like, as well as their avoidance of certain agents, are due to a motor reflex of essentially the same character as the motor reflexes so well known in higher organisms. This reflex consists in swimming, when stimulated, toward a structurally defined end and turning toward a structurally defined side, whatever the nature or position of the stimulating agent. The paper presented a study of a number of flagellates and ciliates, to determine whether such a motor reflex is common. It showed that *Chilomonas*, *Euglena*, *Loxophyllum*, *Colpidium*, *Microthorax*, *Dileptus*, *Loxodes*, *Prorodon*, *Stentor*, *Spirostomum*, *Bursaria*, *Oxytricha* and some others respond to many stimuli by a reflex essentially similar to that of *Paramecium*. It seems probable therefore that the so-called chemotaxis, thermotaxis, tonotaxis, and the like of these groups of organisms are in general, as in *Paramecium*, produced through such a reflex. Whether this reflex plays a part in phototaxis, electrotaxis and geotaxis has not been shown. The paper showed also that many of these organisms are much more sensitive at their anterior ends than elsewhere on the body, and brought out a number of facts in regard to the reactions to localized stimuli.

Notes on the occurrence of Uroglena in the Lafayette water supply. SEVERANCE BURRAGE, Purdue University.

Uroglena is one of the organisms that has become of interest to engineers and biologists on account of the disagreeable oily or fishy taste and odor imparted by it to water supplies. It is apt to occur in the clearest and purest waters. The Lafayette supply is derived from driven wells in the bed of the Wabash river, and before reaching the reservoir is a most excellent and inoffensive water. This reservoir, however, being uncovered, furnishes an admirable opportunity for the growth of any organism. It seems probable that several small ponds—so-called lakes—that lie within a few hundred feet of the reservoir, serve as culture beds for the *Uroglena*, and the reservoir may become inoculated by means of birds and other agents. *Uroglena* may be found in some one of these ponds at almost any time. The Lafayette reservoir was infested with this organism in the late summer and early fall of 1896, and it has reappeared quite regularly ever since, in the warm weather. The species of *Uroglena* occurring here corresponds fairly well with *U. Americana* (Calkins), as described in Massachusetts State Board of Health Report, 1891.

It was not the purpose of the paper to bring out any new facts in regard to the organism *Uroglena*, but merely to record its rather regular appearance in Lafayette.

Remarks on a series of wax-models, illustrating cleavage stages in Crepidula. Thomas G. Lee.

The models shown were made by Mr. B. Eric Dahlgren, one of Dr. Lee's students, at his laboratory at Minneapolis. Mr. Dahlgren seems especially fitted to do this sort of work, if there is a demand for it.

Spermatogenesis in Hybrid pigeons. M. F. Guyer.

Hybrid pigeons exhibit several abnormalities in spermatogenesis. These are most marked in the sterile hybrids. In such, the first thing to strike the attention is a curious bead-like varicosity about the middle of the spermatozoön head. In the development of such spermatozoa the nucleus does not elongate completely, as it does normally, to form the head; consequently, at one point there remains a sort of vesicle corresponding in position to the original nucleus before the ends pushed out to form the long head. Some of the sterile birds showed also a marked degeneration of the germinal cells. In some cases no spermatozoa were matured and many of the cells had degenerated. Often deeply-staining masses of protoplasm each with a large central vacuole were present. In both sterile and fertile hybrids there was much variation in cell division. Inequalities in chromatin distribution were common and multipolar spindles, abundant. The nuclei of the spermatogonia contained sixteen chromosomes, which is the regular number. In normal primary spermatocytic there are eight large ring chromosomes, each apparently being equivalent to two of the spermatogonial type, but in the hybrids there were often more than eight. Sometimes there were as high as sixteen small rings, in which case a doubling of the chromosomes had evidently not occurred. When sixteen chromosomes were present in the spermatocytes they were usually located on two spindles, eight to a spindle. Frequently both large and small rings were present. These peculiarities in chromosome formation may point perhaps to a tendency in the chromatin of each parent species to retain its individuality. If such is the case, then in those cells with two spindles each bearing eight chromosomes, it is evident that after division, some of the new cells will have chromatin from only one of the original parent species and some, from the other. Some of the spermatozoa, therefore, will bear chromatin from one only of these species. It is a well-known fact that the offspring of hybrids are extremely variable, a portion of these variations being

usually in the form of reversions to one or the other of the parent species. The possibility presents itself then, that this reversion may be due to the persistence of the chromatin of only one species in one or both of the germ cells. Carrying the conception still further, the other variations in the offspring of hybrids may be due, perhaps, to the varying proportions of the chromatin of each species in the mature germ cells.

The egg of the Stichostemma. C. M. CHILD.

During the autumn of 1899 a species of *Stichostemma*, probably *S. asensoriatum* Montgomery, was found in great abundance in a park lagoon in Chicago. In this small fresh-water nemertean, the gonads occupy the position usual in nemerteans, *i. e.*, between the diverticula of the intestine. The animal is hermaphroditic and probably more or less completely protandric, though spermatozoa are often found in the same gonads with ripe eggs. The gonad is in the form of a follicle, which is lined with the germinal syncytium. The portion of the syncytium which is to form the egg, containing one nucleus, bulges out into the cavity of the follicle and grows in size so that the follicle is filled. It remains attached to the remainder of the germinal mass by a pedicle, and yolk spheres are formed not only within the limits of the oöcyte itself but also in the protoplasm about the pedicle. As the oöcyte grows, the greater portion of the germinal protoplasm appears to pass into it and all or nearly all of the germinal nuclei disappear leaving a single oöcyte in the gonad. Sometimes two oöcytes instead of one are formed in one gonad. The growing oöcyte forms a membrane about itself, but the stalk remains until the egg is laid, when it is broken off and the membrane, which swells rapidly under the action of water, closes over this portion of the cell also. Thus the oöcyte does not become a distinct cell until the moment of laying.

The pore of the gonad is apparently not preformed, appearing at the time of laying. As it is very small the egg is greatly deformed in its passage, but its protoplasm is so fluid that it flows out easily, in a fine stream, all except the nucleus, which often appears to block the way for a moment and then pops out suddenly. After laying the egg soon assumes a spherical form and the membrane swells to a considerable thickness. Eggs are laid normally in strings somewhat less in length than the body of the worm, and containing two rows of eggs in a considerable amount of slime secreted by the skin, and attached to plants, etc.

Self-fertilization may occur (probably occurs normally in many cases) and is followed by normal development. Almost immediately after fertilization the whole surface of the egg becomes roughened in consequence of ectoplasmic activity, and soon accumulations of liquid appear between the egg and the membrane. Various changes of form occur during the formation of the two polar bodies, and, the vitelline membrane being absent, amœboid processes of the ectoplasm appear at many points. Soon after their formation the polar bodies begin to enlarge and become transparent, and before the first cleavage is completed they have usually disappeared. In the manner of their degeneration they resemble very closely injured or unripe eggs which die in the water. These increase in size very rapidly and become vacuolated and soon the yolk becomes liquid and disappears.

Just before and during the first cleavage pseudopodia-like outgrowths of the ectoplasm are abundant in the region of the cleavage-furrow. The ectoplasm is clearly continuous between the cells.

In the resting two-cell stage, again in the four-cell stage, and between adjacent cells in subsequent stages temporary cavities appear which are filled with liquid. These

increase in size and finally collapse, often opening distinctly to the exterior. The next division begins almost immediately after their collapse. The excretion of fluid during maturation and fertilization, the tendency to vacuolation of the protoplasm observable in the polar bodies and injured eggs and the accumulation of fluid in temporary intercellular cavities during cleavage are probably, as Kofoid suggests concerning similar phenomena in pulmonates, etc., connected with life in fresh water. The cleavage is spiral.

Concerning Cotylogaster occidentalis sp. nov. Preliminary notice. W. S. Nicherson.

An American representative of the trematode genus *Cotylogaster* occurs in the Mississippi valley parasitic in the 'sheepshead.' The animal is from 8–10½ mm. long. The anterior proboscis-like part of the body is terminated by a five-lobed disk surrounding the mouth. The ventral surface bears a compound sucker composed of from 132–144 acetabula of which from 31 to 34 form a median longitudinal row of transversely elongated grooves; the remaining 100–110 are in a single row surrounding the median series. These are rounded or elliptical in outline and not definitely arranged with respect to the members of the median row. Marginal organs are present.

From the dorsal surface near the posterior end rises a broad conical elevation. The excretory pore is at the base of this cone between it and the posterior margin of the sucker. The genital aperture is median, in front of the margin of the sucker. A penis is lacking: the testes are two in number posterior to the ovary. The ovary is smaller than the testes and on the left of a median plane. The shell gland is anterior to the ovary, diffuse. The vitellaria are a pair of elongated laterally placed cords of tissue. The eggs are numerous, spheroidal, destitute of yolk cells. When discharged they contain a fully formed embryo with unforked intestine and simple subterminal sucker at posterior end. The body of the embryo is covered in part by a simple epithelium bearing distinct tufts of cilia.

Studies in Earthworm Chlorogogue. W. J. Rice. Read by title.

A demonstration of slides illustrating the Compound Oösphere of Albugo bliti, as published in the Botanical Gazette, September and October, 1899. F. L. Stevens.

The simultaneous mitoses of the oögonial nuclei, the multinucleate oösphere and antheridial tube, the extrusion of many male nuclei into the oösphere, the fusion of the male and female sexual elements in pairs to form about fifty fusion nuclei as well as the new cell organ, the *coenocentrum* were abundantly illustrated by slides. The peculiar feature of this work lies in the fact that while this species presents a compound oösphore and a multiple fertilization, other related species seem to show only a simple oösphere and a simple fertilization.

Gametes and Gametangia of the Phycomycetes. B. M. Davis. Read by title.

Suggestions toward a classification of plant societies based on topographic development. H. C. Cowles. Read by title.

The early stages of development of ventral nerves in Cyclostomes and Selachians. H. V. Neal, Knox College.

Problem—Is there a difference in the modes of development of ventral nerves in the lower and the higher vertebrates? Investigators differ in their results. Observations on embryos of Squalus and Petromyzon preserved and stained by the raw Roth-Pyrogallic acid method have given some positive results, while such methods as the Golgi, Gold Chloride, Corrosive Sublimate, Palladium Chloride and others fail in the early stages when the nerves are first formed. The raw Roth-Pyrogallic acid

method is advantageous in staining deeply cell boundaries and axis cylinder processes in early stages. The results obtained by the use of this method are: 1. Ventral nerves in Squalus and Petromyzon embryos arise primarily as axis cylinder processes of cells lying in the ventral horn of the neural tube. 2. There are secondarily added to these processes cells from two sources: (*a*) cells which have migrated out from the neural tube in the region of the root of the nerve; and (*b*) cells from the mesenchyma through which the nerve passes. At first these cells take a peripheral position with reference to the bundle of axis cylinder processes (= nerve fibers), but in later stages they migrate into the midst of these processes. 3. The cells thus added secondarily to the nerves do not form nerve fibers as has been held by several investigators, but form simply the primitive or Schwann's sheath. The nerve fibers are from their beginnings the processes of cells lying in the ventral wall of the neural tube as stated above. The mode of development of the medullary sheath has not been determined.

Thus the ventral nerves of these Anamniote forms differ in their development from the same nerves in Amniota only in deriving some of the sheath cells from the neural tube. The sheath cells in Amniota appear to be derived wholly from the mesenchyma (His, Kölliker and others).

The conclusions of Balfour, von Wijhe, Dohrn, Beard, Kupffer and others, that cells migrate from the neural tube into the ventral nerves of Amniote embryo is thus confirmed. The inference that these cells form the nerve fibers is not correct.

On the existence of accessory optic vesicles, based on new observations. W. A. LOCY. Read by title.

New observations on the primary segments of the vertebrate head. CHARLES HILL. This was presented by Dr. Locy.

The development of the adhesive organ and hypophysis in Amia. JACOB REIGHARD. (In conjunction with MISS PHELPS and MR. MAST.)

An account of the development of the adhesive organ appeared in the report of the New York meeting (1898) of the American Morphological Society, published in SCIENCE. The hypophysis develops as an ectoblast thickening connected with the anterior neuropore and lying, in early stages, between the neuropore and adhesive organ. Its subsequent history does not differ essentially from that described for other vertebrates by Haller. It is at no time connected with the entoblast, and unlike the hypophysis of Acipenser, does not, therefore, afford support to Kupffer's interpretation of the hypophysis as a paleostome.

Exhibition of figures for a Normentafel of Amia with an account of methods of photographing the embryo. JACOB REIGHARD.

The method consists in the use of a long focus lens (80 mm. projection lens of Leitz), together with a long camera—the large photomicrographic camera of Zeiss—attached to the wall vertically. This arrangement allows of great focal depth, together with a magnification of 10–20 diameters. The microscope stands on a base-plate provided with leveling screws. Focusing at a distance is accomplished with a device which works the coarse adjustment. Reflectors for regulating the intensity of the shadows and a means of marking the embryo in order to obtain a sharp focus were described.

The breeding habits of Amia. JACOB REIGHARD.

The nests are premeditated structures and are prepared sometime in advance of spawning by the male fish, by biting or tearing away the bottom vegetation. They are not accidental, or mere concomitants of the act of spawning. They may be near or

remote from one another according to the character and extent of the available bottom. Spawning is intermittent and usually covers a period of several hours.

Notes on a Dakota Axolotl. H. L. Osborne.

A new *Axolotl* was found in March, 1899, in Amenia, North Dakota, an occurrence farther north than heretofore known. The body proportions are those of an *Amblystoma*. Its total length is 312 mm. It possesses the following larval characters different from previously known *Axolotls*: (*a*) a dorsal fin beginning on the level of the second body ring, 8 mm. high, running around the abdomen to the cloaca; (*b*) a smooth area of the skin on each side of this in the dorsal region; (*c*) a skin beyond the smooth area in the trunk region minutely warty-roughened, and marked with scattered circular dark spots; (*d*) eyes located one-fifth of the distance from the angle of the mouth to the origin of the third gill; (*e*) the longest of the three gills as long as the head; (*f*) the gills all broadly spatulate and flattened and the margin divided distally. The following characters of the adult are present: (*a*) all the four limbs are completely formed; (*b*) the lungs are fully developed; (*c*) the oviducts are much enlarged and filled with eggs ready for deposition. Characters of the skin, the size and form of the gills distinguish it from either the Mexican form or from the *Siredon lichenoides* of Baird and Girard from New Mexico.

The degeneration of the eyes of the cave Salamanders. C. H. Eigenmann.

Will be published shortly in full in Science.

The arrangement of the single and twin cones in the retina of fishes. C. H. Eigenmann.

Will be published shortly in *The American Naturalist.*

Notes on the Natural History of Polyodon. C. A. Kofoid.

In the Illinois River and its adjacent waters, *Polyodon* is pelagic in habit. Its food is typical plankton, chiefly Entomostraca and the larger Rotifera and Protozoa, with no evident admixture of bottom rubbish or sedentary organisms. In swimming the mouth is held wide open, without the rhythmical respiratory movements common in most fishes, though it is occasionally closed energetically. The plankton is thus strained from the water by the long gill-rakers, and *Polyodon* is a living plankton net. The fish was never observed to use the bill to stir up the bottom or in any mechanical way. It quickly perceives plankton or ground fish added to the water of the tank, and, when feeding, circles repeatedly over the same path, at times dragging the lower fins upon the bottom. The bill isabundantly supplied with sensory structures and serves as an expanded sense organ and not as a mechanical aid in feeding.

On Platydorina caudata. C. A. Kofoid.

This new genus of the Volvocidae has been found in the Mississippi, Illinois and Wabash basins in summer and fall months. It consists of a plate of 16 or 32 similar biflagellate cells arranged in a horse-shoe shaped cœnobium, which bears at its posterior end 3 or 5 tails formed of the matrix and sheath. The two faces are exactly alike, alternate cells upon either face presenting the flagella to the surface. The plate is slightly twisted in a left spiral and the rotation of the colony in locomotion is predominantly from right over to left. The polarity of this genus is the most pronounced in the family being structural as well as physiological. The two transverse axes are also established though their poles are not differentiated. Asexual development is similar to that of *Eudorina* with a subsequent flattening of the ellipsoidal cœnobium and an intercalation of the cells of the two sides. Sexual development not known.

Variation in the sea anemone Sagartia Luciæ.
GERTRUDE C. DAVENPORT.

Sargartia Luciæ is conspicuously marked by a varying number of orange colored bands which run longitudinally. These orange bands were counted in 751 individuals at Cold Spring Harbor. Their number varied from 0–20. The largest proportion had 12 stripes. Secondary maxima occurred at 8, 4, 1 and 16. Longitudinal division was observed in which the twelve stripes were apportioned to the two resulting individuals as follows: 9–3; 4–8; 5–7. Also such divisions as 3–3; 7–1 were noted. Hence the variation in the number of stripes is dependent upon fission. Division, so far as observed, was aboral-oral and was usually accomplished within of 24 hours. By feeding to repletion, division already begun could be delayed, even apparently prevented. When cut longitudinally into halves regeneration was rapid. Even small fragments artificially obtained reproduced normal individuals. Normal division was observed only in diglyphic types. Monoglyphic individuals are plentiful and occur as the result of division of diglyphic forms. Basal budding and fragmentation are believed to be very common method of multiplication of this species.

Variation studies on Pectinatella magnifica.
C. B. DAVENPORT.

The number of spines on the statoblasts of *Pectinatella* from Chicago was counted in over 800 cases. The law of distribution of frequencies was deduced by quantitative methods. The skewness is positive, that is there is an excessive tendency toward large numbers. This fact of variation in the form-unit agrees with the fact that the other races of *Pectinatella magnifica* and the other species of the genus have a larger modal number of spines. The ontogenetic causes of the variation and of abnormalties was considered.

C. B. DAVENPORT.
Secretary.

*SOME OF THE PROBLEMS OF LIMNOLOGY.**

IF the object of science is to correlate and state the results of observation in such a way as to produce mental economy, it can hardly be said that limnology has developed very far as a science. It is certainly still true that much of our knowledge regarding lakes is in that condition of detailed statement whose mastery involves great mental exertion. Through this stage all sciences have passed and signs are not lacking that limnology will soon reach the position now occupied by older branches of biological science. To secure this result the student of lake life must attempt to solve problems rather than merely to state facts.

Two classes of problems present themselves to the limnologist: the first, scientific; the second, practical. The first comprises the problems raised by the study of the lake as a unit of environment. The second class concerns itself with the question of the lake as a unit of economic production. The answer to the practical question depends on the correct solution of the scientific problems.

In attempting to solve these problems the limnologist finds himself constantly hampered by the lack of knowledge through which he may interpret the results which he reaches. The acquirement of this knowledge seems to me the first and most necessary step toward bringing exactness and comprehensiveness into our views of lake biology. We count the constituents of the plankton, but are not able to state the significance of the results which we reach. Laborious and slow as the process of counting is, I see no escape from the conclusion that it will remain for a long time the only exact way of ascertaining the facts regarding the assemblage of plants and animals which constitute the plankton. For the

* Address in opening discussion on 'Methods and Results of Limnological Work,' at the meeting of Naturalists at Chicago, December 28, 1899.

interpretation of these results more knowledge is necessary. I shall content myself with pointing out a few directions in which this interpretative knowledge must be gained, if the results of observation are to be of real scientific value. First in importance I should place the knowledge of the chemistry of the plankton, from which its possible nutritive value can be learned. The unit system of counting, as advocated by Whipple, is undoubtedly a great advance on mere enumeration, but the units thus employed are not even units of mass, much less units of chemical composition. The difference in the amount of ash between diatoms and crustacea, not to speak of other differences, is so great that no direct comparison, however exact, of cubic contents can teach us the significance of the two groups in the lake's plankton. Chemical analyses only will do this and these must be be stated both in terms of bulk of the centrifuged or settled plankton, and in terms of the average individual plant or animal, as determined by counting. Every limnologist, therefore, should be careful to avail himself of the opportunity presented by the appearance of a monotypic plankton to collect it in sufficient quantities for analysis. I have myself to confess that I have neglected three opportunities of collecting *Daphnia hyalina* in these large quantities. Similar opportunities have no doubt been neglected by many of us, but the necessity of this information is so pressing that I am sure we must all agree in placing it first on the list of desiderata.

It may be possible to collect the ordinary plankton in large quantities and to separate it into its constituents more or less completely by means of one of the centrifugal milk separators. The difference in density between the diatoms, the cyanophyceæ and the crustacea is so great that there ought not to be any serious difficulty in separating the plankton into at least three groups. So far as I am aware, no experiments have been made in this direction, but the work must be attempted and in some way or other we must secure single groups, or, if possible, single species of plankton plants or animals in quantities sufficient for chemical analysis, or our results will continue to suffer from their present indefiniteness.

A second line of investigation which demands much study concerns the biological significance of the constituents of the plankton, especially of the plants. Many observers have noted that certain algæ are eaten more freely by the crustacea than are others, yet no such careful and continued observations have been made as to enable us to make any general statements on the subject. Evidently, however, this work must be done, or even the chemical knowledge gained by analysis will fail to disclose the real interrelations of the plankton plants and animals.

A third point of equally great importance concerns our knowledge of the chemistry of the water of the lakes and of its gaseous contents as related to the plankton. Many waters have been analyzed, yet few or no attempts have been made to correlate these analyses with the nature and abundance of the several plankton species. Still more conspicuously is this true of gas analyses. We suppose, for instance, that in certain lakes the accumulation of the products of decomposition in the deeper waters prevents the animals of the upper regions from descending into the cooler waters of the lake, yet we are at present entirely ignorant of the nature of these products, whether they are gaseous or other, and of the way in which they are able to affect so powerfully the biological conditions of the sub-thermocline. Numerous similar questions are pressing for solution.

A fourth class of questions comprises those raised by the relation of the littoral area to the limnetic region of the lake.

We may be sure, however, that these questions will be very slowly answered, since they open the most complex questions of lake life and those most difficult of solution. We know enough already to be confident that general statements regarding the relation of littoral and limnetic regions are very unsafe. It is true that lakes with steep banks are plankton-poor, yet it does not follow that lakes with large littoral areas are correspondingly rich in plankton. It certainly is not true that lakes are poor in plankton in proportion to their depth, so that even these most simple relations between the shore regions and the deeper water require careful and extended study in order that any safe conclusions may be drawn.

I have contented myself with pointing out a few of the directions in which limnology needs to move if the stock of facts which limnologists are accumulating is to receive an adequate interpretation. In order that such a result may be reached in the future, it is necessary for the student of lakes to propose to himself definite questions and to work as definitely toward their solution. The time has passed when the publication of the limnetic species, or even the quantitative determination of the constituents of plankton can materially further the advance of science. This work was useful, chiefly in disclosing to us the problems of limnology. These are now before us, in part at least, and the time has come when the student of lakes must attempt to answer some of them.

E. A. BIRGE.

UNIVERSITY OF WISCONSIN.

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*A PRELIMINARY ACCOUNT OF SOME OF THE RESULTS OF THE PLANKTON WORK OF THE ILLINOIS BIOLOGICAL STATION.**

THE Illinois River drains an area of 29,000 square miles, is over 500 miles in length, and has at low water a fall of but 31 feet in the last 227 miles of its course. The low gradient is due to the fact that, in a part of its course at least, the present stream and its bottom lands occupy the bed of an ancient outlet of Lake Michigan. The present flood plain is but partially developed—the bank height rarely exceeding 15 feet—and overflows are frequent and extensive. Floods rise from 16 to 24 feet above low water levels, increasing the total extent of water area to over 700 square miles. The impounding action of the bottom lands, the low gradient, and the backwater from the Mississippi River combine to prolong the flood period. The stream at low water is from 500 to 1500 feet in width and three to 12 feet in depth, and by reason of the dams forms a series of slackwater pools with a sluggish current of about one-half mile per hour. The waters of the adjacent lagoons, bayous, and lakes are also shoal and attain a high temperature during the period of summer heat. The water is rich in organic matter being derived from the run-off and seepage of fertile prairie soil and is further fertilized by the sewage of a metropolis and of a score of smaller cities along its banks, in addition to the offal of extensive cattle-yards and large amounts of distillery wastes. Under these conditions it is not surprising that ammonia, nitrites and nitrates are present in excessive quantities. The high temperature and the abundance of nutrition thus favor the development of the aquatic flora and in sequence that of the aquatic fauna.

Quantitative investigations of the plankton have been carried on at somewhat regular and frequent intervals from June, 1894, to April, 1899, in a series of representative localities near Havana, Ill.; (1) the main stream; (2) Spoon River, a typical tributary; (3) Quiver Lake, rich in vegetation much of the time and fed by spring water; (4) Thompson's Lake, a large (6 × .5 miles) open lake, fed by the river and usu-

* Abstract of address in opening discussion on Methods and Results of Limnological work at meeting of Naturalists at Chicago, December 28, 1899.

ally free from vegetation; (5) Phelps Lake, an ephemeral body of water without vegetation; (6) Flag Lake, a large swamp, choked with vegetation, rarely drying up in the summer. At times of high water all these localities are submerged. The quantitative and qualitative examination of the collections, as yet incomplete, indicate the following more or less tentative conclusions:

1. The waters contain a typical freshwater plankton, that is, one composed of limnetic organisms usually cosmopolitan and identical with or closely related to the plankton organisms of larger bodies of water. It has much in common with the plankton of German streams, and at low water is remarkably like that of the Nile at a corresponding stage. The admixture of littoral forms in the open water of the lakes and in the river is surprisingly small in the number of individuals, though presenting a considerable range of species. In all about 500 different species have been found, of which at least one-third may be called limnetic.

2. There is a marked seasonal variation in the amount of the plankton. A spring maximum, usually in May or June, follows the winter minimum and is in turn followed by an apparent mid-summer minimum in August. An autumn maximum of secondary importance precedes the return to the winter minimum. These statements are based, as usual, upon catches made with the silk net and are subject to the error arising from the leakage of the smaller organisms through the silk. The correction of this error by supplementary methods tends to eliminate the summer minimum and to augment the autumn maximum. The volume of plankton in the spring maximum is from 20 to 50 times that of the winter minimum. These fluctuations are repeated from year to year, but vary in time of appearance, in extent, and in relative development in successive years and in different waters. Irregular fluctuations also of great extent may occur in any locality especially during the summer and fall.

3. There is a marked seasonal variation in the organisms composing the plankton. During the winter minimum the chlorophyll bearing forms are relatively few, the plankton being composed of a few hibernal and a smaller number of perennial species principally of Rhizopoda, Copepoda and Rotifera. The presence of ice on the surface, and the low temperature of the water (0°–4° C.) do not interfere with the growth and reproduction of this winter plankton. Fouling of the water by an excess of sewage under the ice may, however, exterminate the animal life of the water. As the temperature rises, the brown flagellates and the diatoms increase in number and subsequently the green flagellates and other chlorophyll-bearing organisms multiply rapidly. This is accompanied by a marked development of animal forms, especially Cladocera and Rotifera, resulting in the spring maximum. This culmination is rarely due to the excessive development of a single species, but is typically polytonic. A rapid decline of the vernal species, principally Entomostraca and diatoms, produces the midsummer minimum, characterized by the relatively small number of individuals, and the very large number of species, principally Rotifera and the smaller green flagellates. The autumn maximum appears after the equinoctial rains and is often composed in large part of Synchæta, Synura, and diatoms. This is also the period of maximum numbers of the ciliate Protozoa. The total number of species in the fall plankton is not large and the predominant forms are few.

No two years present throughout the same sequence of species in the same relative numbers. In some instances, species abundant in one year have not been found

or have occurred but sparingly in other years. As a rule the numbers of individuals and their seasonal range are alike subject to considerable fluctuations from year to year. The qualitative differences in the plankton from season to season are due to the adaptations of different species to different seasonal conditions, especially in the matter of temperature, and the differences from year to year are perhaps to be correlated with the fluctuating environment.

4. At times of high water all plankton stations at which examinations have been made are in one continuous body of water, and the plankton is quite similar throughout, especially in spring floods. As the water recedes and the several lakes and the river emerge as distinct units of environment, the planktons are very quickly differentiated by the disappearence of certain species and the multiplication of others as seasonal changes progress, so that in a few weeks each locality presents its own peculiar assemblage of organisms. This phenomenon is repeated from year to year and occasionally several times in one year, depending on the fluctuations in the river levels. The different localities examined thus present at times of low water great local differences in the amount and constitution of the plankton, corresponding to contrasts in the environment, especially in respect to vegetation, source of water and temperature. The assemblages of organisms characteristic of a given locality, though varying somewhat, present many points of similarity from year to year.

5. Waters in which aquatic plants, such as *Ceratophyllum*, *Elodea*, *Naias*, *Potamogeton* and *Nymphæa* are abundant, are, in the localities examined, as a rule poor in plankton. The removal of the vegetation by wind and flood or by fishermen's seines is followed by an increase in the amount of plankton. The same lake may then be plankton-rich one year and plankton-poor the next, according to the amount of vegetation it contains. The phyto-plankton thus apparently replaces the coarser aquatic flora.

6. The local distribution of the plankton in lakes with somewhat uniform conditions of bottom, water supply, and vegetation is remarkably even, in so far as the volume of the plankton is concerned, the variation from the average falling within the 30 per cent. observed by Apstein in the lakes of northern Germany. The distribution of many species is far less uniform. In the river, except near the mouths of large tributaries the distribution of the plankton is even more uniform than it is in the lakes, the variation in the amount of the plankton from shore to shore is less than 10 per cent. Under even conditions the amount of plankton in the current of the river ($\frac{1}{2}$ to $2\frac{1}{2}$ miles per hour) varies but little from hour to hour and day to day—being often within 10 per cent. and rarely exceeding 20 per cent. at one point of observation at Havana. Catches made at intervals of 10 miles in the lower 220 miles of the river show a considerable uniformity in amount and constitution, except where modified by local conditions such as sewage on tributary waters.

7. The plankton of tributary streams is relatively very small in amount and is composed of a different assemblage of organisms. The immediate effect of tributary waters is to dilute the plankton. The river is thus a unit of environment with its own peculiar fauna and flora.

8. Flood waters quickly and profoundly affect both the amount and the composition of the plankton, diluting it and washing it rapidly away toward the sea and to a slight extent replacing it with the more or less sessile forms torn away by the current of the creeks and of the river itself. The silt of flood waters is often disastrous to many species of Entomostraca. The recovery in the volume of the plankton after floods is

usually rapid, the chlorophyll bearing organisms, especially the green flagellates appearing first, followed in turn by the animal plankton, Protozoa, Rotifera and Entomostraca. The resubmergence of the bottom lands doubtless starts anew encysted forms left by receding waters. In general the recovery from the flood culminates in a plankton maximum of greater or less importance, depending upon the season of the year and the extent of the flood.

9. Species present in great numbers are often extremely variable, as for example, *Brachionus bakeri*. The varieties are often local, or seasonal, but may also be coëxistent. Variation is often very great in the case of species reproducing parthenogenetically as the rotifer just mentioned, in other rotifers, in Daphnia and in Bosmina.

C. A. Kofoid.

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*MALARIA AND TUBERCULOSIS.**

The visit of certain English physicians to Italy during the Christmas vacation, was in some respects so remarkable as to make a full description of it of general interest. Commendatore Florio, a wealthy and beneficent citizen of Palermo, invited certain English physicians first to Rome, in order to see the work done by their Roman brethren in the investigation of malaria; and, secondly, to Palermo, to inspect a sanatorium for the cure of consumption which Commendatore Florio has erected under the advice of Professor Cervello, of the University of Palermo. The party of English physicians with their friends was about twenty in number, among them being Sir T. Lauder Brunton, Sir Walter Foster, M.P., Professor Clifford Allbutt, of Cambridge, Dr. Manson, C.M.G., and Dr. Cantlie, of the London Tropical School. Dr. Malcolm Morris and Dr. St. Clair Thompson represented the National Association for the Prevention of Tuberculosis, and Dr. Gibson represented Edinburgh. They were received at Charing-cross Station by Commendatore Florio's representative and travelled with him to Rome, where they remained for some days in conference with Professors Grassi, Bignami, Celli, and Bastianelli. Signor Grassi, now Professor of Zoology in the University of Rome, is a Sicilian, and while a professor at Catania carried out the remarkable researches on the propagation of the eel which secured for him the Darwin Medal of the Royal Society.

Professor Grassi, since his removal to Rome, has performed work perhaps no less remarkable in demonstrating the propagation of malaria. This story is not only so interesting in itself, but of such vital importance to our own colonies, some of which are desolated by malaria, that I will try to sketch briefly what will be told in full by Professor Grassi in an illustrated volume to appear very soon both in Italian and English. A few years ago M. Laveran won a place for himself on the distinguished roll of Frenchmen of science by discovering in the blood of malarious patients a minute parasite, a form belonging to the humblest order of animal life. Three different but closely allied species of parasite are severally concerned in the causation of the three kinds of malarial fever. M. Laveran's researches were fully verified by observations both in Europe and in America, and further observations made of their behavior in man. Certain suggestive facts led Dr. Manson to suspect that a gnat or gnats were the means of propagating the parasite, and, having himself returned from the tropics, he pressed Major Ross, then of the Indian Medical Service, to follow up this clue in India. Himself an ardent engineer and now chief of the Liverpool Tropical School, Major Ross set to work with some success, but unfortunately his efforts were impeded by

* From the London *Times*.

the active discouragement of his official superiors in India. Thus hampered he was able, nevertheless, to ascertain that a gnat (a culex) is the means of propagating a malaria in birds but not, as it turns out, any one of the malarial parasites of man. At this point the Roman physicians took up the subject, Professor Grassi on the side of zoology, Professor Bignami of pathology, Professor Celli of prevention. Their researches have proved, and Major Ross has since verified their statements in West Africa, that malaria in man also is propagated by a gnat, but not by a culex; the enemy of man is a dapple-winged gnat, scientifically known as *Anopheles claviger*. Professor Grassi showed to his visitors a large number of beautiful drawings illustrative of the anatomy of this gnat, and of the life of the parasite within it. The gnat, in sucking the blood of an infected man, takes in the parasite; this in a spheroidal form may be demonstrated in the stomach of this fly, and its course, followed closely as it penetrates the walls of the stomach, reaches the juices of the body, as a tiny worm-like creature, and thus wriggles onwards into the salivary (or poison) gland of the insect, whence it is again returned to man by the proboscis. Thus between man and the anopheles these parasites maintain their cycle of life. No man, and no dapple-winged gnat, no malaria.

Not the least interesting part of the visit was the excursion with the professors into the Campagna, where two farms had been selected for experiment. In the one protection was given against the access of the insects; in the other no such precautions were taken. Other things were equal; in the former farm was no malaria, in the latter malaria prevailed as before. Fortunately *anopheles* rarely bites men on the move; secreting itself in their cabins or chambers it attacks them while at rest—especially at night, when by certain apparatus its inoculations may be avoided. Whether *anopheles* can be extirpated or not is a large and difficult question. This gnat breeds in pools of a certain kind, not quite stagnant, but supporting confervæ (Limna), on which its larvæ subsist. From such pools these larvæ were collected and exhibited in abundance to the visitors. A small spoonful of common petroleum oil will destroy all the larvæ in a square yard of such water, and it seems possible, therefore, that by drainage, where possible, and the supplementary use of oil the insect might be removed from large areas. In turning up new ground such pools are apt to form and breed the gnat, a result which might be avoided by no very difficult provision. By his generous invitation Commendatore Florio has enabled skilled English observers to verify these invaluable researches—researches into the minute habits of very obscure creatures which will have nevertheless a very large effect upon the well-being of man in fertile tracts of the world now too pestiferous for continuous occupation, at any rate, by white men.

The cure and prevention of tuberculosis has of late years excited the public interest more than of malaria, of which fell disease our home population now happily knows little. From Rome Commendatore Florio's guests were taken to Palermo, and were entertained in the Villa Igiea, the exquisite palace, for I can call it no less, in which consumptive patients are to be received and treated on the open air system, with all advantages that a beautiful and uniform climate, a lovely site, and every luxury of life can give. The sanatorium, which will be completed in a few months and then opened by the King and Queen of Italy, is built outside Palermo upon the rocks on which the deep sea of the bay actually beats. In the clefts of these sunny rocks are marble benches, temples and grottoes,

and about their sinuous margins winds terrace upon terrace broadening up to the plateau on which, some forty yards from the sea, the sanatorium stands, sheltered behind to the north by the mass of Monte Pellegrino. Of this great and splendid curehouse, Professor Cervello is the physician in chief, and Baron Fassini, whose charming qualities as a host endear him to his guests, is the director. The most perfect modern systems of cure have been studied in Germany and elsewhere by Professor Cervello, whose dietetic regulations will be rendered less oppressive by the ministrations of a first-rate French chef, and whose draughts of fresh air will be administered to those who desire it in a beautiful yacht of 300 tons, which is always to be at the call of the patient. In Palermo Commendatore Florio himself, the Messrs. Whittaker and other residents did their utmost by brilliant hospitality and constant kindness to make the visit of the English physicians and their friends a memorable one; and not the least delightful of their memories will be that of the sanatorium and its grounds illuminated by myriads of lamps and hundreds of men with torches as they steamed away from the harbor on the night of their departure.

It is urged on behalf of the Villa Igiea that Palermo is the nearest place to the Continent of Europe where so delightful a climate is to be had, where there are so many resources for quiet cheerfulness and so much charm for the eye and imagination. But it is needless to add that residence in a fairy place, with a French cook and a yacht at command, can be no cheap cure. The sanatorium when finished will accommodate about 100 patients, who must necessarily belong to the wealthiest class of society.

In respect of finance I must add that Commendatore Florio did not issue his generous invitation with any eye to commercial advertisement. He has built the Villa Igiea with no intention of personal profit; after providing a fund for repairs and contingencies, all surplus is to be set aside for building a sanatorium or sanatoriums for the poor. He was also wishful that English physicians should see at work a method of inhalation of the vapor of formaldehyd which Professor Cervello believes will prove a very valuable ally in his treatment of pulmonary phthisis. This method the Professor has used for some time in the consumption wards of his hospital with, as it appears to him, satisfactory results. Whether this method turns out to be valuable or not, and this time only can show, there can be no doubt even now that the Villa Igiea offers incomparable advantages as a sanatorium for the modern system of cure of the most grevious of all pests of man.

SCIENTIFIC BOOKS.

Social Laws. An Outline of Sociology. By G. Tarde. Translated from the French by Howard C. Warren, Assistant Professor of Experimental Psychology in Princeton University, with a preface by James Mark Baldwin. New York, The Macmillan Company. 1899. Small 8°. Pp. xii + 213.

This little book consists of a collection of lectures delivered by M. Tarde at the *Collège Libre des Sciences Sociales* in Paris during the month of October, 1897. The French edition appeared in 1898 under the title, *Les Lois Sociales; Esquisse d'une Sociologie.* It has now come forth very opportunely in an English dress, which enables those who do not keep a close watch for important contemporary foreign literature to acquaint themselves with the views of one of the leading thinkers of our time. It does not claim, as the author is at pains to say, to give a summary of his three principal works, The Laws of Imitation, Universal Opposition, and Social Logic, but rather to show what there is in common in these works, and how they together constitute a system of social philosophy.

There is one respect in which Tarde may be

compared with Malthus. Each, in studying man and society, arrived at a biologic law applicable to both man and the organic world below man. There is, however, this difference, that while Malthus discovered a law of biology that had not as yet been recognized by biologists, Tarde has discovered a law well known to biologists, but scarcely as yet recognized as a law of sociology. Another difference is that the Malthusian law, while it holds universally in the animal world and is true of man as an animal, is not true of rational man, having been superseded by the law of mind, which has inaugurated a new dispensation; whereas the Tardean law, if we may so speak of it, is as true of the rational man as of the animal man and the animal, and, broadly interpreted, takes in the inorganic as well as the organic world. This Tarde has perceived, and he expresses it in this book in the following words: "The time has come when it would be in place to set forth the general laws governing imitative repetition, which are to sociology what the laws of habit and heredity are to biology, the laws of gravitation to astronomy, and the laws of vibration to physics" (p. 61). Nor is this the first time that he has said such things. Sweeping comparisons of the kind are frequent in the works named. We may refer especially to the footnote on page 37 and the discussion on page 159 of the second edition of the *Lois de l'Imitation*.

What, then, is this Tardean law? Most readers have become familiar with the five leading terms of Tarde's philosophy: Imitation, Repetition, Opposition, Invention, and Adaptation. The one most dwelt upon is *imitation*. Next to this *invention* has come to be recognized as having been given a special meaning by Tarde. We read less about *repetition* and *opposition* in their new rôles, while *adaptation* scarcely receives any amplification at Tarde's hands.

First, then, as to *imitation* as a social law. That men have always imitated one another, especially in what they deemed good, is, of course, well known, but it had not been perceived that this is the basis of all custom, of all morals, and of the social order. Imitation is specially characteristic of the lower races and of the higher animals. The first of these facts is a common remark of travelers and ethnographers. The second is attested by language itself, the word for *ape* in most languages being that for mimicry. In the development of mind imitation is the natural and necessary precursor of imagination, and all early art consists in mere copying. Who has not noted the slavish conventionalism of aboriginal and even civilized art patterns? Below the psychic plane and in the simple world of life, the homologue of imitation is clearly *heredity*, *i. e.*, reproduction of what already exists. But this is only transmission from one body to another. The same process is going on within the organic body. Here it takes the name of *nutrition*, and growth itself is a form of imitation. Below the life plane and throughout the inorganic world something very similar takes place. Here it is simply *impact*, producing motion, and the physical homologue of imitation is *causation*. Imitation is the universal conservative principle of nature.

Repetition is included in imitation. It is the mechanical effect of which imitation is the physical cause. It results whether the force behind it be psychic, vital, or physical. It is therefore rather an accessory term expressing the necessary consequence of imitation than a new coördinate fact in Tarde's system.

Opposition is the resistance with which the effort to repeat, reproduce, and perpetuate constantly meets from the impinging environment. It is, as Tarde says, 'universal.' In human society it embraces not only the conflicts with the elements and with wild beasts, but the far more formidable conflicts among races and nations—*bellum omnium contra omnes*. It is also oppression and revolution, monopoly and competition, and the strife of capital and labor. In the organic world it is nothing short of the universal 'struggle for existence,' so clearly set forth by Darwin. In a word, it represents the environment. In the physical world it is the innumerable obstructions in the path of every moving body, producing collisions and arresting, deflecting, constraining, and transmuting motion.

Invention is the first step in advance. It is not universal, but appears sporadically. It is

well described by Tarde in the following passage: "Social transformations are explained by the appearance, to a certain extent accidental as regards time and place, of certain great ideas, or rather by a considerable number of ideas, small or great, easy or difficult, usually unperceived at their origin, rarely brilliant, generally anonymous, but ideas always new, and which, by reason of this newness, I will allow myself to baptize collectively as *inventions* or *discoveries*" (Lois de l' Imitation, p. 2).

Invention breaks away from the bonds of imitation. Instead of exact repetition and reproduction of the old pattern it adds something, however little, to it, and this in the direction of improvement. This is a permanent gain, because the improved state immediately becomes in turn the subject of imitation. The word invention is given the greatest possible latitude. It embraces everything that departs in the least from the strict line of exact reproduction and perpetuation of the existing type. A thousand causes lead to it. Tarde has not worked these out as well as he might. Necessity may have been the primordial mother of invention as a condition to further existence. But with the growth of mind a certain degree of nonconformism naturally arose. The obstacles to the satisfaction of desire (opposition) bred discontent and induced efforts to overcome them. Mind is the naturally aberrant element in the world, and deviations from the straight path of custom resulted. At long intervals, few and far between, even as now, the inventors, *i. e.*, the innovators, made their appearance, with the results described by Tarde.

What, now, is the relation of invention to imitation and opposition? It is the product of the joint action of both of these. We saw that imitation and repetition constitute causation in the domain of thought and ideas, also in that of life. They are the *force* at work in these fields. They are the *causa efficiens*, the *vis a tergo*, that propels the vital and psychic worlds. As such they obey the Newtonian law, and the motion resulting is in straight lines. Cause and effect are in intimate contact, and this repetition, or rectilinear motion is simply continuance, *i. e.*, *continuity*. But opposition interferes with this, tends to arrest motion, constrains and transmutes it. So far the process is *genetic*. But mind is *telic*. It is a *final cause*. It was developed as a means of overcoming opposition, of surmounting obstacles, of avoiding resistance, and of circumventing counter-forces, in order to attain foreseen ends. This is the essence of invention, which is therefore born of the repetitive *nisus* in conflict with the obstructive environment, *i. e.*, of imitation and opposition.

As invention seems to be wholly the product of the higher mind and late in origin, it might be supposed that, unlike imitation, repetition and opposition, it would have no homologue in the animal world or on the plane of mere vital existence, and still less in the field of purely physical phenomena. Not so, however. Just as in the organic world, heredity is the homologue of imitation, and environment is the homologue of opposition, so *variation*, the product of heredity and environment, is the homologue of invention, the product of imitation and opposition. Dropping now into the physical world, where, as we saw, causation is the homologue of imitation, and collision is the homologue of opposition, we see that the product of these is *evolution*, which is therefore the true cosmic homologue of invention.

Adaptation, as the final great social law, is perhaps more fully treated in this little book than in any of Tarde's previous volumes. He devotes the third and last chapter to it, occupying 58 pages of the English text. And yet this is the least satisfactory part of Tarde's system thus far. This is not because it is not equally important, but because it is not set forth with anything like the originality and power that characterize his treatment of the other great laws. This is perhaps partly because he found the field thoroughly worked over by the biologists, and there is so little new in sociological adaptation. But he says justly that adaptation "expresses the profoundest aspect under which science views the universe." He perceives that it is a progressive coördination of social phenomena, and in a sense a synthesis of repetition and opposition, just as in biology it is a development as the result of a synthesis of heredity and environmental resistance. But he does not work out the mode of operation of this law in a way analogous to that in which Darwin worked

it out in biology, nor does he give us the sociological equivalent of natural selection, philosophically expressed by Herbert Spencer in the phrase 'indirect equilibration.' Adaptation is an indirect social equilibration, the complete analysis of which remains to be made. Tarde, indeed, dwells on the fact that adaptation consists in a certain harmony and unity in the social world, from which it is clear that he sees the dependence upon it of the social order. Between adaptation and invention, in Tarde's wide use of both terms, we have an antithesis which in its essential aspects is the same as the antithesis between order and progress. It is just here that sociology naturally falls into the two great subdivisions of social statics and social dynamics.

It may be objected to the above analysis that it does not follow closely enough the method of the work under review, and that it goes back to the author's other works and even lays the conceptions of other authors under tribute. But this could scarcely be avoided in anything beyond pure exposition. As a matter of fact very little is said in this book of the great law of invention. But how could this be avoided in any glance at his system? The aim has been rather to summarize that system and present it as a whole, while laying special stress, as Tarde claims to do in this work, on the relations that the leading laws sustain to one another. But the system is a large one. It is thoroughly elaborated in a long series of books, and different readers may see many things very differently. Again, the excessive condensation necessary to a short review compels the omission of so many important things that no claim is made to having done justice to that system.

The English text forms a neat and convenient little volume, printed in clear type and tastefully brought out. The translation is free and the original is rendered in elegant English without obscurities or gallicisms. In a few cases it is open to the charge of being just a little too 'liberal.' Only one such need be referred to. On page 168 the original: "Et ce cas tend à se généraliser par les progrès de la machinofacture," is rendered by: "And this sort of case tends to become more general with the improvements in the manufacture of machinery." Aside from the fact that this does not convey the idea of the original, there is certainly a loss in avoiding the word *machinofacture*. This is a word of Tarde's special mintage, struck off with all due reserve in a footnote to page 174 of the *Logique Sociale*, and freely used thereafter, often as here, without italicizing, on the assumption that his readers now understand it. But it is as good English as French, and while in both languages the word *manufacture* has lost its literal implication of *handmade*, and embraces machine-made products as well and for the most part, still it was a fine stroke to call attention by this new term to the primitive form of industry, and to emphasize in one word the enormous stride that industry has taken, which, with all its blessings, is at the same time the fundamental cause of the chief socio-economic problem of modern times.

LESTER F. WARD.

Die Conchylien der patagonischen Formation. Von H. VON IHERING. Mit 2 Tafeln. *Neuen Jahrbuch für Mineralogie, Geologie und Palæontologie.* Jahrg. 1899. Bd. II. (S. 1–46 Taf. I., II.).

In this paper Dr. von Ihering has made an important addition to the invertebrate paleontology of the Patagonian beds. The paper is based upon a collection of invertebrate fossils recently made by Mr. C. Bicego of the Sao Paulo Museum, from the typical Patagonian beds at the mouth of the Santa Cruz river in southern Patagonia. According to Dr. von Ihering about 50 species are represented in the collection. Among these are nine new to science and some three or four new varieties.

Not the least important features of Dr. von Ihering's paper are the geological questions discussed in it. Following Dr. Ameghino, von Ihering considers the Patagonian and Supra Patagonian (Santa Cruz) beds, as quite distinct and proceeds to set forth at some length the paleontologic and lithologic features which according to him are characteristic of each. Happily we have here for the first time a definite locality given where the Patagonian beds may be observed in their typical development and exhibiting those lithologic and paleontologic features, which, according to Dr. von Ihering, dis-

tinguish them from the Supra Patagonian beds. This alone is a most important point, since it gives us a definite base from which to start in a comparative study of the Tertiary formations of Patagonia, as they are understood by Drs. von Ihering and Ameghino. It is to be hoped that the latter author will also, in the no distant future, realize the importance of giving at least some one definite locality at which each of the various geological horizons (Mesozoic and Tertiary) that have been named by him at various times may be found and studied. It is alone by such frankness, which should characterize the work of naturalists everywhere, that we shall be able the more easily to arrive at a true solution of the age and relations of the various geological formations of Patagonia.

According to Dr. von Ihering (see page 4 of his paper), the fossil shells of the Santa Cruz (Supra Patagonian) beds are usually enclosed in a soft, sandy matrix, while those of the Patagonian beds are firmly imbedded in very hard clay stones. Dr. von Ihering does not contend that these conditions are absolute throughout the two series, but that the former prevails in the upper series while the latter predominates in the lower. He also finds the faunas of the two deposits to be quite distinct. On pages 6 and 7 he gives a list of 67 species as belonging to the Patagonian beds. He finds only 16 of these 67 species in the Santa Cruz (Supra Patagonian) beds. On page 38 he gives a number of genera and species which according to him are characteristic of the Santa Cruz (Supra Patagonian) beds.

Regarding the lithologic characters given by Dr. von Ihering, it should of course be remembered that he has himself never visited Patagonia, and has therefore to rely upon the nature of the matrix adhering to the fossils and the reports of Mr. Bicego, whose observations in southern Patagonia have been limited to the region about the mouth of the Santa Cruz river. But even in that locality Mr. Bicego certainly could not have failed to observe that the lithological conditions given by Dr. von Ihering, as prevailing in the Patagonian beds, are in reality, of extremely limited extent when compared with the entire thickness of fossil-bearing rocks at this locality. There are, as Dr. von Ihering says, many instances of hard clay-stones or other concretions literally filled with the shells of mollusca, and occasionally a stratum of hard sandstone, which is also fossiliferous. The superior resistance which such materials offer to erosion are apt to mislead the not too careful collector as to their relative importance, and with such material at hand, and to be had only for the picking up, he is likely to overlook many of the real gems which will richly reward the collector if he turns to the several hundred feet of soft sand and clays and examines them *in situ*. On weathering away, however, the usually soft delicate shells are reduced to powder and rendered worthless. If Mr. Bicego had occasion to examine the bluffs along the south side of the Santa Cruz river, between the village of Santa Cruz and Direction hill at the mouth of the river, he must have seen numerous shell layers in the soft crumbling sands and clays, which constitute by far the greater portion of the 350 feet of sediment exposed in the bluffs. A notable example of this is to be seen in the bluff of the river about one and a-half miles above Direction hill and just above where formerly stood the temporary observatory erected a few years ago by the United States Steamer *Brooklyn* (?). At this point the bluffs rise directly from the river and there is a continuous stratum of loose sand, filled with shells. This stratum is about six inches thick and a quarter of a mile in length. It is located at a height of only five to ten feet above high water and can scarcely fail to attract the attention of anyone passing along the foot of the cliff. At various altitudes above it, other similar shell-bearing layers may be seen in the same bluff. At Direction hill and along the coast to the southward are many other strata of soft materials rich in fossils, while if any one will take the trouble at low tide to walk out over the surface of the beach he will frequently see the soft tosca literally filled with fossil shells. In one soft stratum near the mouth of the river the writer found a bed about eight inches thick and 20 to 30 feet in length, composed almost entirely of the shells of *Struthiolaria ornata*, which according to von Ihering is characteristic of the Patagonian beds, mingled with a few

specimens of *S. Ameghinoi*, which, according to the same author, is found only in the Supra Patagonian (Santa Cruz) beds. Moreover, there are a number of blocks of the hard matrix from the mouth of the Santa Cruz river and now in our collections in the museum, mingled together in the same block are to be seen various species, some of which, according to von Ihering, are characteristic of the Patagonian and others of the Supra Patagonian (Santa Cruz) beds.

Dr. Ortman, who is making a thorough study of our collections of Tertiary invertebrates from Patagonia, is entirely unable, from the list of species given by Dr. von Ihering (page 38), as characteristic of the Patagonian and Supra Patagonian (Santa Cruz) beds, to refer any of the numerous horizons from which our collections have been made to either the one or the other series of beds, on account of the mingling of these alleged characteristic species. He finds represented in our collections from the typical Patagonian beds at the mouth of the Santa Cruz river all but one of the genera and species given by von Ihering (p. 38) as characteristic of the Supra Patagonian (Santa Cruz) beds. This one exception (*Voluta ameghinoi*) he finds in our collections from the Mt. of Observation associated with *Cardium puelchum, Cardita patagonica = inæqualis, Siphonalia noachina*, which according to von Ihering are characteristic of the Patagonian beds.

Of the sixty odd species given by von Ihering (pp. 6–7) as coming from the Patagonian beds, Dr. Ortman is able to at once designate thirty-five of them as occurring in our collections associated with one or more of the characteristic species of the Supra Patagonian (Santa Cruz) beds as enumerated by von Ihering (p. 38), while every single one of the latter species has been found with von Ihering's characteristic Patagonian species. It will thus be seen that it is clearly impossible to distinguish these two formations by their faunas, while the lithologic characters are even less distinctive. Nevertheless there are in certain instances decided lithologic and faunal differences at the various localities, and it sometimes happens that such differences are quite marked even in the same actual horizon and at neighboring localities. To such local differences due to the varying conditions attending the deposition of the beds, is due the confusion regarding their stratigraphic relations. Before making more extended observations, the present author like Drs. von Ihering and Ameghino, was in favor of considering these beds as composed of two distinct formations. Subsequent observations, made at many different localities, have convinced me, however, that the Patagonian and Supra Patagonian beds do not represent distinct time intervals, but that sedimentation was continuous from the base to the top of the series, and that the strata of which they are composed all belong to one formation (the Patagonian formation). The rocks composing these beds were laid down, as the fossils clearly indicate, either in a shallow sea or as littoral deposits. The shallow sea deposits constitute the Patagonian phase of the series, while in the Supra Patagonian phase are included the sands and muds that were accumulating simultaneously along the shores and smaller estuaries as their included fossils clearly indicate. The Patagonian phase prevails at the base and the Supra Patagonian at the top of the series, but neither is restricted to any definite horizon within the limits of the entire series.

On page 29, Dr. von Ihering enters upon a discussion of the age and relative position of the various sedimentary formations of Patagonia, giving a review of the conflicting opinions expressed at different times by various authors on these questions. He also points out the erroneous ideas formerly held by Dr. Ameghino regarding the relative, stratigraphic position of the *Patagonian, Supra Patagonian and Santa Cruz beds*. In this general *résumé* he has fallen into an error regarding the position taken by myself in a former paper with reference to the stratigraphic position and age of the *Pyrotherium beds* of Ameghino. Since others, more especially Drs. Ameghino and Roth, have also misunderstood the position taken by me at that time on this question I shall improve the present opportunity to explain a little more fully my views concerning the Pyrotherium beds. I did not, as these authors seem to think, place the Pyrotherium beds above the Santa Cruz beds. I placed them in the Cretaceous, where according to Ameghino they belonged.

I did, however, seriously question both their Cretaceous age and the stratigraphic position assigned to them by the Ameghinos. From a study of Dr. Ameghino's description of the mammalian fauna found in them, I advanced the opinion that there were mingled together in the so-called Pyrotherium fauna, representatives from two or more distinct horizons. This opinion Dr. Ameghino has since admitted to be a fact and has separated his Pyrotherium beds into two distinct formations which he separates by a long time interval. My succeeding two years of field-work in Patagonia have further convinced me as to the correctness of my former views regarding the *Pyrotherium beds*.

In referring on page 30 to the paleontologic evidences advanced by myself regarding the age of the Pyrotherium beds, Dr. von Ihering is quite right in saying that the tooth mentioned and figured by myself as belonging doubtfully to Pyrotherium, is a tooth of Astrapotherium, and also in maintaining that in the process of development of any mammalian phylum, certain organs may early attain a considerable degree of specialization, while the animal as a whole remains quite primitive in its structure. Everyone I presume will readily grant this, but would Dr. von Ihering have us entirely overlook the extremely close relationships, brought out on almost every page of Dr. Ameghino's papers on the Pyrotherium fauna, as existing between the so-called Cretaceous fauna of the Pyrotherium beds and that of the Santa Cruz beds, which latter are now known to be not older than Miocene? Many of the mammals described by Ameghino from the Pyrotherium beds are scarcely specifically distinguishable from allied forms in the Santa Cruz beds. In a few instances Ameghino has himself admitted that he can not distinguish forms from the Pyrotherium beds from well-known Pliocene and Pleistocene animals. Among such may be noticed the large gravigrade edentate which he is unable to distinguish from Mylodon, more than likely for the very good reason that it is a tooth of Mylodon from the Pleistocene deposits that occur throughout the greater part of Patagonia.

Considering the highly specialized character of the Pyrotherium fauna and its remarkably close relationship as a whole to the Santa Cruz fauna, in connection with what we already know of the character of the stratigraphic work of the Ameghinos in Patagonia, the Cretaceous age of the Pyrotherium beds can no longer be seriously considered. Moreover the stratigraphic observations of Dr. Roth, Señor Mercerat and myself are all at variance with such a position for them.

On page 45 Dr. Von Ihering includes the Cape Fairweather beds in the Tehuelche formation as is also done by Ameghino. If I mistake not the term Tehuelche formation was proposed by Doering for the great bowlder or shingle formation of Patagonia. Unfortunately I have never been able to see Doering's paper. If I am correct in this the Cape Fairweather beds should not be included in the Tehuelche formation since they are quite distinct and unconformable as I have been able to observe at several different localities. The Cape Fairweather beds are Pliocene while the Bowlder formation is unquestionably Pleistocene. A curious account of the relations of these two deposits has been published by Dr. Ameghino in the *Geological Magazine*, for January, 1897. On page 17 in speaking of these two series of beds he says, after quoting at some length from a letter from his brother, Charles Ameghino: "According to this the bowlders were deposited at the bottom of the sea and over them there extended at other periods a vast formation of marine shells." In this instance Dr. Ameghino has again reversed the true stratigraphic relations as he did for many years with the Patagonian, Supra Patagonian and Santa Cruz beds.

J. B. Hatcher.

Geological Survey of Canada. By George Mercer Dawson, C.M.G., F.R.S., etc., Director. Annual Report. (New Series.) Vol. X. Ottawa, December, 1899.

This volume, comprising 1046 pages of text accompanied by eight maps and illustrated by twelve plates and a number of figures in the text, has just been issued by the Department and forms publication No. 679 of the Catalogue of volumes published by the Canadian Survey. It is addressed to the Hon. Clifford Sifton, M.P., Minister of the Interior, and contains many valuable reports of exploratory and geo-

logical surveys, both in the little known districts of Canada, as well as in the densely populated and older provinces of the Dominion of Canada. The volume opens with a 'Summary Report of the Operations of the Geological Survey for 1897,' by the Director.

This report describes the various publications issued during the year, the geological information on the Yukon District, Museum and office work, and also the result of boring operations in Northern Alberta. The Director also gives reports of explorations and surveys in British Columbia, Manitoba, Ontario, Quebec, Hudson Strait, New Brunswick and Nova Scotia. It is followed by Mr. W. McInnes's report 'On the Geology of the Area covered by the Seine River and Lake Shebandowan Map-Sheets,' in the gold-bearing series of Northern Ontario. The Laurentian, Couchich and Keewatin Steep Rock series, and Animikie series of rock formations occurring in that district are described and their contacts carefully noted. The localities which are productive and of economic value receive special attention and notes on the glacial geology are also included. This forms Report II. of the volume.

'Report on the Area included by the Nipissing and Temiscaming Map-Sheets,' by Mr. A. E. Barlow, forms Report I. of this volume, and comprises 302 pages of text, including two appendixes: (1) 'List of Elevations'; (2) 'On some Cambro-Silurian and Silurian Fossils from the Lake Temiscaming, Lake Nipissing and Mattawa Outliers,' by Henry M. Ami, of the paleontological staff. Mr. Barlow's report forms a very complete study of an important area of archæan rocks, in which he has described the main geological features with a great deal of pains, and gone into details of the composition of the gneisses met in the *Laurentian* of the area in question, together with their petrographical relations; also in the 'Grenville series' as developed and recognized by him in that district.

The *Huronian* system is then discussed, and the breccia-conglomerates, the diabase and gabbro and granites met with carefully described, along with their relations to the post-Archæan eruptives. He then devotes the succeeding chapters to a description of the Cambro-Silurian, Silurian and Pleistocene areas included within the two maps of the district examined, and has a chapter on 'Economic Geology' describing the valuable deposits of gold, silver, nickel, copper, iron and other minerals occurring there. Regional descriptions follow, which will prove of great value to prospectors and miners in a district, full of beautiful lakes and waterfalls and magnificent scenery, and holding economic minerals of untold wealth.

Report J, by Mr. R. Chalmers, 'On the Surface Geology and Auriferous Deposits of Southeastern Quebec,' contains upwards of 160 pages of very valuable reading and illustrations, with statistics of the gold production of the Beauce and Chaudière River region of Quebec. The pleistocene marine shore-lines, the rivers and lakes, the denudation that has taken place, together with the action and products of the Appalachian glacier, the Laurentide ice, and that of the local glaciers, as well as of floating ice, are all discussed. The gold-bearing region is then described. This includes the history of mining in the Gilbert River, River du Loup, Famine River, Mill River, Slate Creek, Main Chaudière Valley, Little Ditton River, etc. The probable source of the alluvial gold is then given by the author.

'The Mineral Resources of New Brunswick,' by Professor L. W. Bailey, forms Report M of this volume and is a most welcome report. This province ought to receive as well as give more attention to the materials of economic value, which occur in the earth's crust as it is developed in that portion of the Dominion of Canada by the sea. The geological formations, in which iron, copper, nickel, antimony, lead, silver, manganese, coal, bituminous shales, graphite, peat, gypsum, granites, marbles, dolomites, ornamental stones, infusorial earths, mineral springs, and various other materials of economic value to man are to be found, are described, and the mode of occurrence of these useful materials given, together with their locations. A map of the minerals of the province accompanies the report.

Report S contains the customary and useful report of the 'Section of Mineral Statistics and Mines,' by Mr. E. D. Ingall. It contains upwards of 200 pages of valuable notes on all the

economic minerals of Canada from all the provinces, and tables of their value and of the amount produced and exported or consumed at home.

The volume contains a very complete index, which adds greatly to its value. H. M. Ami.

North American Slime Moulds. By T. H. MacBride. New York, Macmillan & Co.

The appearance of this book must be gratifying to all American students of the slime moulds. It is gratifying also that it comes from the pen of one who has long been identified as an ardent student of these lowly organisms, and whose former contributions to the literature of the subject have shown signs of a conscientious student. It follows closely after the appearance of two monographs covering the species of a much wider geographical area and including the American forms; the one by Mr. George Massee of the Kew Herbarium, London, Eng., and the other by Mr. Arthur Lister, of the British Museum, London, Eng. Nevertheless, it will be found convenient for American students because it is limited to American species, and especially because the author has had an opportunity of comparing a larger number of specimens representing the American species, than perhaps were accessible to the monographers mentioned above.

Each of these three authors arrives at a different conclusion after the usual course of reasoning in the selection of the name for the entire group. Massee uses the name *Myxogastres* first applied by Fries in 1829. Lister employs the name *Mycetozoa*, given by de Bary, in 1858, which included the *Acrasieæ* of recent discovery and the *Myxogastres* of Fries. MacBride choses the name *Myxomycetes*, substituted by Link in 1831 for Fries *Myxogastres*, but emended by deBary to include the exosporous species, the endosporous species only having been treated of by Fries and Link. The *Myxomycetes* of deBary thus formed a subdivision of his *Mycetozoa*. The author then says (p. 13), "Myxomycetes (Link) de Bary must remain the undisputed title for all true slime moulds, endosporous and exosporous alike."

In the introduction the author briefly describes the habits and morphology of the organisms. It is evident from his discussion on page 9 et. seq., that he considers them to be plants. But he very sensibly recognizes the difficulties here presented by a group of organisms, whose vegetable characteristics on the one hand ally them to the amœboid animals, and on the other hand give rise to no higher group. He says "it is purely a matter of indifference whether we say plant or animal, for at the only point where there is connection there is no distinction." There are given directions for the collection and care of material, and also is given a good bibliography.

In the taxonomic part of the book, the *Myxomycetes* (Link) de Bary are regarded as a class which is divided into three sub-classes. The first sub-class is the *Phytomyxineae* Schroeter, with one species, *Plasmodiophora brassicæ* which produces the common club foot of cabbage, turnips and other cruciferous plants. The second sub-class, the *Exosporeæ* Rostafinsk, includes two species, the well known *Ceratiomyxa fruticulosa* (*Ceratium hydnoides*) and *C. porioides*, which may be only a variety, or form, of the first named, as suggested from material collected by the writer at Ithaca, and indeed Lister considers it a variety only (Mycetozoa, p. 26). The third sub-class the *Myxogastres* (Fries) MacBride, represents the *Myxomycetes* properly speaking, and it is here that the large number of genera and species are to be found. 'Keys' are given first to the orders of which five are recognized. Then under each order are given keys to the genera and species, with synonymy and diagnoses, which latter are further made lucid by copious notes in most cases. The distribution of each species as at present known to the author is also given.

In his treatment of the nomenclature the author has not been led into many very painful upheavals of antiquated names, though in several cases the species appear under unfamiliar names, the most notable being *Mucilago spongiosa* for *Spumaria alba*. Forty-four genera are treated and over two hundred species. These are illustrated by eighteen excellent plates. The work is published in the attractive way so characteristic of many of Macmillan's books.

George F. Atkinson.
Cornell University.

BOOKS RECEIVED.

L'Année biologique. YVES DELAGE. Paris, Schleicher frères. 1899. Third year, 1896. Pp. xxxv + 841.

The Theory of Electrolytic Dissociation and some of its Applications. New York, The Macmillan Company. 1900. Pp. xii + 289. $1.60.

The Psychology of Religion. EDWIN DILLER STARBUCK, with a preface by WILLIAM JAMES. London, Walter Scott; New York, Charles Scribner's Sons. 1900. Pp. xx + 423.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF BIOLOGY.

THE regular meeting was held on January 8, 1900, Professor F. S. Lee presiding.

Mr. David Griffiths spoke of the structure of certain species of the *Sordariaceæ* and briefly reviewed the work which has been done on the group. Certain species were taken as types of the principal genera, and their life history traced, *Sordaria finicola*, *Podospora coprophila*, *Hypocopra equorum* and *Sporormia intermedia* being spoken of especially. Some time was devoted to a discussion of the much mooted question of fertilization in this and kindred groups. The principal methods of spore distribution were outlined.

Dr. Wm. J. Gies reported upon the changes which may occur in lymph after the administration of protoplasmic poisons. Quinin did not interfere with the usual influence of dextrose although it did suppress the action of leech extract. The results with dextrose, therefore, indicate that the increase in the quantity of lymph following its injection in large quantity is due mainly to physical factors. In the case of leech extract, on the other hand, there is an interference with the action of the physiological factors that appear to be responsible for the changes usually brought about by this lymphagogue. That the increase in the amount of lymph after large quantities of dextrose have been injected is not due primarily to increased capillary pressure, as is held by Cohnstein and Starling, was shown in one of the experiments in which quinin caused the death of the animal, and yet from which the lymph continued to flow for three hours. After injecting arsenic, which is said to very greatly increase the permeability of the blood vessels, especially those of the portal system, there was little in the flow and character of the lymph resembling the usual effect of lymphagogues. It appears, therefore, that Starling's hypothesis of increased capillary permeability does not fully account for the action of lymphagogues, and that the mechanical theory of lymph formation fails as long as it does not explain the most striking phenomena of the process—those following the injection of Heidenhain's lymphagogues or Asher's 'liver stimulants.' The physiological theories of Heidenhain and Asher would explain them.

Professor Frederic S. Lee said that the duration of the life of voluntary muscle in mammals after the death of the individual has not been well known. Under the author's direction, Messrs. Adler and Bulkley have been investigating this in cats and rabbits. In each experiment the animal was killed, a particular muscle was excised and stimulated by electric shocks at five-minute intervals, and the resulting contractions were recorded. The muscles used were the *soleus* (deep red), and the *tibialis anticus* (pale). Each survived several hours, the maximum for the red muscle being 14 hours and 37 minutes, and for the pale, 12 hours and 20 minutes. It is known that, in comparison with white muscle-fibres, red fibres contain relatively more sarcoplasm, which is nutritive in function, and relatively less fibrillar substance, which is the contractile part. This may perhaps account for the longer survival of the red muscle. So far no constant difference in duration has been observed between the cat and the rabbit. In both the red and the pale muscle the decrease of irritability was gradual, but occasionally in the *tibialis* there was a sudden fall at the end of about one hour, the irritability then continuing at a low ebb for hours but with a gradual decline. The sudden fall may have been due to the early death of the white fibres, which intermingled with red ones, occur in the pale muscle. Besides the theoretic interest, the above results have a practical bearing, since they show that mammalian muscle can readily be used for experimental purposes in the physiological laboratory. This is now being done at Columbia University.

Professor Henry F. Osborn reported upon

recent additions to the American Museum from the Cope collection through the munificence of President Jesup. (For a fuller account see SCIENCE, N. S., XI., p. 77.)

Bashford Dean described the condition in seven eggs of *Myxine glutinosa* which he had received from Professor A. E. Verrill. These had been collected in 1880 on the Newfoundland banks in water of 90 and 150 fathoms. The egg membranes were regarded as more specialized than those of Bdellostoma.

FRANCIS E. LLOYD.
Secretary.

DISCUSSION AND CORRESPONDENCE.

DO THE REACTIONS OF THE LOWER ANIMALS AGAINST INJURY INDICATE PAIN SENSATIONS?*

IN a posthumous article with the above title by the lamented Professor Norman is contained the chief substance of what was to have been his doctorate thesis. It comprises new facts and a statement of those that are old in a way which will interest especially the psychologists and gratify to no small degree the physiologists—or some of them. While the author answers the titular question in the negative, as his main thesis, 'lower animals' indicates for him only those species up to and including the flounder. Moreover, the paper is remarkably free from opinions based on analogy, the evidence being weighed as its author thinks solely for what it is worth and regarding the particular species experimented upon alone.

The report begins with a proper adverse criticism of that mode of argument in a circle which bases presumption as to the mode of consciousness concomitant to movements, on these same movements taken as expressive of certain modes of consciousness. He follows rather the purely physiological method of considering movements as the immediate consequence of physical stimulation, the psychic factor not entering the problem at all. Certain experiments seem to the author to prove the correctness of this point of view.

The most striking and classic of these experiments were made on the common earthworm (*Allolobophora*). If such a low animal be divided at its middle transversely, only the posterior half shows those squirming and jerking movements which, anthropomorphically viewed, seem to indicate pain; the anterior half (containing the brain) crawls, as ordinarily, away. Now if each of these halves be halved, again the posterior segment of each squirms while the anterior halves crawl away. This same process may be continued with precisely like result until the pieces are no longer large enough to crawl independently. This striking phenomenon is explained in part by the two sets of muscular fibers in the worm, one longitudinal, causing the squirming and jerking, and the other circular, which produce the crawling. Why in the posterior segments the former set should be initially stimulated and in the anterior the latter set, Professor Norman says he does not know. For its purpose the experiment seems conclusive. Similarly, if a swimming leech be cut in two, both parts, after a pause, swim off as if nothing had happened. Like events take place with other species of worms, the anterior or brain part being regularly that undisturbed by the extraordinary stimulus.

The abdomen of a hermit crab may be cut in two without any 'but a very slight response' from any remaining movable organ. *Limulus* stops a few seconds when four or five abdominal segments are cut away, then proceeds quietly breathing as before. Its order of events is regularly: cessation of breathing, flexion of abdomen, pause, extension of abdomen, respiratory movements. *Geophilus* cut in two in the middle continues its crawling, the front half going forwards and the rear half backwards. Millipedes divided while walking do not hasten nor stop nor jerk. Dragon flies lose parts of their abdomens without any appreciable change in position. As was long ago pointed out, bees continue to eat when their abdomens are cut way during the process.

Lastly, sharks and flounders, provided a current of water circulate through their gills, will allow the most tedious and deep-going cutting operations on their heads without the slightest

* By the late Professor W. W. Norman, University of Texas, with Additional Note by Jacques Loeb. *American Journal of Physiology*, Vol. III., No. VI., 1 Jan., 1900. Pp. 270–284.

appreciable movement indicative of pain or even of sensation.

In the 'additional note,' Professor Loeb points out as the two chief results of the investigation: "(1) In a great number—perhaps the majority—of lower animals injuries cause no reaction which might be interpreted as the expression of pain sensations. (2) In the limited number of cases where injury is followed by motions which have been considered as the expression of pain sensations (as in the case of worms) a closer analysis shows that this interpretation is unjustified."

This article is noteworthy not least for what it neither says nor implies, namely, that animals other than those there considered probably do not feel pain. Notwithstanding this most commendable modesty of opinion on the part of its author, certain considerations present themselves therefrom, which are of too great moment both to psychology and to physiology to remain unanswered. The problem may be properly considered as insoluble—yet well worthy of debate. It will not be maintained that these animals do experience pain when they are injured, *but only that they may for all that experiments prove to the contrary.* Analogy and reasonable presumption are our only methods when inexperiencable sensations are in question and the former of these at least works both ways.

The lowness of the investigator's subjects in the animal 'scale' is worthy of preliminary notice. On this account it would at first sight seem that the author's and Dr. Loeb's opinion was more valid, on the common supposition that 'so low a grade of consciousness could not include actual, stinging pain.' The nervous systems of these worms and echinoderms and fishes seem undoubtedly too simple to allow of the presence of organs for pain such as on the whole seem probable in man and his congeners. The highest, highly differentiated animals require painful sensations as a means teleologically protective of their different organs; in the lowest orders, on the other hand, this need does not exist, for their relative simplicity of plan makes possible the regeneration of any lost part or organ or even the perfecting of an individual from a part artificially cut off from another individual. It is therefore extremely reasonable even from the pan-psychistic viewpoint to suppose that organs of pain would be undeveloped in these very lowly forms. The simplicity of neural structure in these orders makes it certain almost that much, present in higher forms as organs correlated to consciousness of various modes, would here be lacking. The worm and the starfish, simply because they are in a less degree, physiologically speaking, individuals than is a dog or a man, require fewer of those organs on which a continuance of individuality depends. But while this is so, perhaps, the sort of pain under discussion is not man's degree of pain, but rather that grade of painful consciousness proportionate to the needs of the animal in which it may or may not be experienced. The difference is not one of kind but one of degree, and a degree suitable to the biologic needs of the particular species may be present, commensurate not to the complexity of a nervous system even, but perhaps only to the necessity of the preservation of individuality—a necessity in some of the species experimented on obviously exceedingly small.

In view of the great similarity functionally between the neural structures of the higher animals and those of man, no one perhaps would seriously deny consciousness to, say, an elephant or an ape. To damaging stimulation these animals react much as does man, but it is a quite gratuitous presumption that the earthworm and the flounder would react to a destructive excitation in a manner even comparable to that in which these higher forms react. To suppose this would be to employ again only a sort of the objectionable anthropomorphism. Because the elephant or the cat with a remarkably elaborate system of innervated, muscled, and jointed limbs, reacts in a characteristic way to injury, there is no reason to expect the Nereis or the starfish to react similarly in any sense. The rabbit even, with essentially all the motor mechanism which man possesses, 'expresses' pain often times only by attempts to get away and by an increase in the breath-rate; indeed this dyspnœa is often the physiologic anæsthetizer's only sign that more ether is urgently demanded. It is not necessary then because the lowest forms of animals do not act

as mammals act under injury to presume on that account an absence of that degree of unpleasant consciousness which corresponds to the higher animal's pain. One might *à priori*, from difference in structure and in function both, expect wholly different reactions to stimuli or even none at all. Qualitatively as well as quantitatively the reactions of any two genera may differ to any indefinite degree.

Again that relative deficiency of simplicity of neural organs, natural to the low orders, may be and presumably is correlated with a like deficiency in the duration of the sensations represented by these organs. The time of continuance of a sensation occasioned by a momentary stimulation is perhaps determined by the number and extent of something comparable to association-currents running either between different parts of the neural unit or between these units extended spatially, or both. The former of these conditions may be simpler in the lowest orders, and the latter wholly or at least partly lacking. 'Reverberation,' in a word is less, the simpler the nervous organ. Professor Norman expressly noted in most of his experimental reports a period of quiet on the animal subject's part, representing nervous shock. It is a pure presumption to conclude that such a condition is not 'painful' to the animal. In all the higher animals severe pain is essentially asthenic in its effect on the organism. Limulus, cited by the writer, shows this especially well, and furthermore presents yet further evidence of painful or destructive sensation in the extreme abdominal flexion, the general concomitant of pain, noted in the experiments. This depressing period being past, and the perhaps only pseudo-individual being by the injury in no way incapacitated for its customary movements (because of lack of coördinating neural mechanism), these movements soon proceed as if nothing had happened, as indeed perhaps nothing had happened to more than an insignificant independent portion of the quondam individual.

Another consideration, quite old but on that account not less reasonable as it seems to the present writer, may be based on the biologic principle that nature does not act by leaps, that continuity is the all-pervading principle of evolution and so of psychophysical development. Man undoubtedly has consciousness and at times pain; the lowest organism has a minimum, but always some, of both, 'consciousness,' here indicating experience correlate with mechanical function, and 'pain' that sort of disadvantageous experience correlated with injury to the biologic egotism of the individual—very general terms, but therefore the more useful. Between these two zoologic extremes, the maximum and the minimum of developed life, all animal life has place and has accordingly, from this theoretical point of view, some degree or other of what, for want of a better term, is called pain. Each individual in its degree, be it man's degree or the earthworm's, has feeling, from this the philosophical view point, even as it has motion through space or within its organs. Let one who is disposed to deny this say with what genus sensation ends as one looks down the closely crowded scale of life—is it between man and the monkey or between the alligator and the flounder? However large the empirical gap at present between any two genera may be, the problem is not altered, for like biologic principles actuate them all, and strongest of these principles normally is the preservation of the individual. To this end, perhaps, pain developed, and to this end it everywhere, in the long run, works. This proposition is more than a mere speculative presumption, for observation inductively originated it and continually supports it. To get beneath it were to solve at length the great problem of Job, were to go deeper than empirical science can. It is a principle too firmly fixed in the philosophy of biology, so to say, to be shaken by the necessarily wholly negative result of experimentation where the conditions are so far from those of man, the judge.

George V. N. Dearborn.
Harvard University.

PLANT MATERIAL FOR LABORATORY USE IN THE SCHOOLS.

For more than a year there has been offered through the Ithaca Botanical Supply Co. plant material suitable for laboratory use in first courses, and for demonstrations of some of the organs and processes which it is rather difficult

for beginning students to prepare. This work was undertaken at my suggestion by some students who were in need of financial assistance in their laudable endeavor to obtain a college education. It was undertaken both for the purpose of affording some aid in this way, and also for the purpose of assisting teachers and schools, especially secondary and normal schools, in the supply of material which is often difficult to obtain.

It should perhaps be stated that neither I, nor the botanical department here, has any official connection with, nor financial interest in, the scheme. At the same time I have taken a lively interest in the work in order to be assured that the material and the preparations should be of the first order. The persons who make the preparations are thoroughly familiar with modern methods and have attained a high degree of skill in preparing them. The permanent slides showing sexual organs and sexual processes in plants of the different groups are excellent and very beautiful. I am quite sure that those who are familiar with good technique will be quite surprised at the high degree of excellence presented in these slides, and certainly they represent the structures in a strikingly accurate manner. They put up in addition to other material, a 'high school set.' Persons or schools desiring further information can obtain a price list by addressing 'The Ithaca Botanical Supply Co.,' Ithaca, N. Y.

GEO. F. ATKINSON.

DO FISHES REMEMBER?

A RECENT paper* by Professor L. Edinger, entitled 'Haben die Fische ein Gedächtniss,' is primarily a statement of the conclusions which its author has reached as a result of his questionaire, 'Do Fishes Remember?' sent out in 1897. These conclusions are prefaced by some discussion of comparative psychology in general and some account of the sense-powers of fishes. The former is judicious but not new; the latter is convenient though not complete. Dr. Edinger is inclined to accept the decision that fishes do not hear sounds, though he seems not to know of the experiments of Dr. F. S. Lee, experiments more conclusive than any he reports.

Dr. Edinger's question as to memory is not about the existence of certain feelings of a thing as having been experienced before, but about the possibility of permanent associations, of after-effects of experiences. He asks concerning the fish nervous system, "Is this apparatus capable of in any way preserving impressions made upon it; do there exist after-effects due to previous experiences?" p. 16. Or, in other words, "Can impressions which are new to the animal, gain an influence on its activities; especially can they preserve this influence for a considerable time?" p. 17. He decides in a rather half-hearted way that they can, on the basis of the evidence obtained from the answers to his questionaire and elsewhere. He summarizes this evidence as follows: "(1) The inborn impulse to flee can be lessened by the animal becoming accustomed to impressions which formerly frightened it, but this tameness is lost if new stimuli enter into the experience. The impulse to flee can also appear in the presence of stimuli which have never been present before. Animals become afraid. By habit the sight of the one who feeds them may take the place of the optical or chemical stimulus which ordinarily leads to the act of feeding" p. 28.

Dr. Edinger's limitation of fishes' powers of forming associations and being influenced by them more or less permanently, to the single cases of tameness, fear and associations between the feeder and feeding, is misleading. It is no characteristic of fishes' mentality to form such habits rather than others. The prominence of such in the answers to the questionaire is due, not to the mental constitution of the fish, but to the interests of the observers. As a matter of fact the questionaire proceeding seems a very awkward way of answering the question about the permanent effects of novel experiences. One can, as has been shown in the December number of the *American Naturalist*, get direct evidence of the fact and demonstrate it to a class in the space of five hours.

Although familiarity with animal psychology proper and a bit more ingenuity might have

*Reprinted from *Allgemeinen Zeitung*, München, 21 und 23 October, 1899.

made Dr. Edinger's work more effective and his presentation much briefer, one cannot help feeling great satisfaction at seeing an eminent neurologist realize the value of comparative study by psychological as well as morphological methods. One must also admire the caution and thoroughness with which Dr. Edinger examines animal behavior. Above all one rejoices to see a piece of work in comparative psychology which presents facts without quarreling over the meanings of words.

Edward Thorndike.

Teachers College,
Columbia University.

THE GERMAN CONSULAR SERVICE.

Mr. Richard Guenther, Consul General of the United States of Frankfurt, writes to the Department of State that the 'seniors' of the Merchants Association of Berlin have addressed a memorial to the Prussian Secretary of Commerce, and at the same time to the Chancellor of the German Empire, which appears to be in response to an inquiry from the Secretary of Commerce, and states what reforms in the German consular service are deemed necessary. The following is a synopsis of the somewhat lengthy document: The main duty of the consul should be to make careful and detailed reports concerning economic occurrences in his consular district. These reports should give not only the figures of the exports and imports, but should also deal with the development of the commerce and the home industries of the country. The consul should be able to point out these conditions upon his own initiative, as well as in response to inquiries from home. He should be well informed about commercial matters at home, as well as in touch with the business world of his district. Means should be at his disposal for travel and he should be compensated for services rendered. Knowledge of the language of the country, as well as of the leading languages of the world, should be of prime consideration. The promotion system of Great Britain should be followed, whereby consuls are transferred between countries where the same languages and similar economic conditions prevail, so that transfers of a consul from China to Russia and thence to Spanish America, for example, should be avoided. Reports concerning the commerce of the foreign country should give comparisons with previous years and be published at home in such a manner as to reach all interested. The letter says that these requirements are more or less realized in foreign countries. The consuls of the United States of America especially have rendered very useful services to the commerce and industries of their home country and have furnished proof that the establishment of commercial consulates bears rich fruit, in spite of the fact that a consul can hardly acquire such special knowledge of trade conditions in the several branches as an agent of some business house. The letter endeavors mainly to show the great desirability of substituting the large number of German 'Wahlkonsuln'—*i. e.*, German merchants resident in some foreign country who act as consuls —by regularly paid consuls, who will give their whole time to their consular duties, and states that a reform is expected mainly from an increased and improved service in the regular consulates, recommending the appointment of commercial attachés to the important consulates, as has already been done at Chicago, Buenos Ayres and Constantinople. It is recommended that the qualifications for appointment as consuls should be of a more practical nature and not so much the mere knowledge of law. The letter also calls attention to the great usefulness of the Philadelphia Commercial Museum.

EDUCATION IN THE UNITED STATES.

The United States educational exhibit at the Paris Exposition will include a two-volume work entitled 'Education in the United States,' which has been planned and edited by Professor Nicholas Murray Butler of Columbia University.

The work consists of nineteen monographs, which, taken together, give a complete view of the present educational activity of the United States. It is proposed to present copies of the work to the leading governments, public libraries and educational institutions of the world, and the public will be given opportunity to purchase copies at a moderate price.

The several monographs which constitute the work, and their authors, are as follows:

1. Educational Organization and Administration—Andrew Sloan Draper, president of the University of Illinois, Champaign, Ill.

2. Kindergarten Education—Susan E. Blow, Cazenovia, New York.

3. Elementary Education—William T. Harris, United States commissioner of education, Washington, D. C.

4. Secondary Education—Elmer Ellsworth Brown, professor of education in the University of California, Berkeley, Calif.

5. The American College—Andrew Flemming West, professor of Latin in Princeton University, Princeton, N. J.

6. The American University—Edward Delavan Perry, Jay professor of Greek in Columbia University, New York.

7. Education of Women—M. Carey Thomas, president of Bryn Mawr College, Bryn Mawr, Pa.

8. Training of Teachers—B. A. Hinsdale, professor of the science and art of teaching in the University of Michigan, Ann Arbor, Mich.

9. School Architecture and Hygiene—Gilbert B. Morrison, principal of the manual training High School, Kansas City, Mo.

10. Professional Education—James Russell Parsons, director of the college and high school department, University of the State of New York, Albany, N. Y.

11. Scientific, Technical and Engineering Education—T. C. Mendenhall, president of the Technological Institute, Worcester, Mass.

12. Agricultural Education—Charles W. Dabney, president of the University of Tennessee, Knoxville, Tenn.

13. Commercial Education—Edmund J. James, professor of public administration in the University of Chicago, Chicago, Ill.

14. Art and Industrial Education—Isaac Edwards Clarke, bureau of education, Washington, D. C.

15. Education of Defectives—Edward Ellis Allen, principal of the Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.

16. Summer Schools and University Extension—Herbert B. Adams, professor of American and institutional history in the Johns Hopkins University, Baltimore, Md.

17. Scientific Societies and Associations—James McKeen Cattell, professor of psychology in Columbia University, New York.

18. Education of the Negro—Booker T. Washington, principal of the Tuskegee Institute, Tuskegee, Alabama.

19. Education of the Indian—William N. Hailman, superintendent of schools, Dayton, Ohio.

EDUCATION ADMINISTRATION IN THE STATE OF NEW YORK.

IN his annual message to the Legislature, Governor Roosevelt refers to the proposed reorganization of the State of New York and the Department of Instruction as follows:

The University of the State of New York, with its Board of Regents, is an institution peculiar to this Commonwealth, and one now venerable with its 116 years of history. Its exercise of authority over higher education has been of very great public service, and its methods and standards have exercised a wide influence for good upon those of other States. These facts have led to the adoption, by the people, of an amendment to the constitution of the State, whereby the University itself and its organization under a Board of not less than nine regents, has been provided and safeguarded in the organic law.

The Department of Public Instruction, on the other hand, concerned chiefly with the supervision of all the free common schools of the State, supported by public taxation, has grown to a vast importance; for the number of children of school age in the State has largely increased, and nine-tenths of them attend no other institution than the public school. The work done in both departments has been, in the main, excellent and needful to be done; they are amply worthy of the confidence and continued support of the people. But that their work could be done better, if the two systems were unified, is a proposition hardly open to question. The problem has been not whether unification were desirable, but by what means this end was to be attained.

From the point of view of the public interests, it is neither desirable nor practical merely to extend the jurisdiction of either department over the other. The University convocation, at its annual meeting in July, 1899, requested the Governor to appoint a commission for the purpose of recommending a practical plan of unification, and in accordance with this suggestion the following commission were appointed:

Frederick T. Hollis, Daniel H. McMillan, Judge Joseph Daly, William Kernan, Robert F. Wilkinson, and the Secretary of the Board of Regents, and the Assistant Superintendent of Public Instruction. All were men of the highest standing, of trained capacity, and specially interested in the whole subject. I cannot too heartily thank them for their invaluable and wholly disinterested labor for the public welfare.

This commission, after careful consideration, has arrived at suggestions embodied in a report suggesting statutory changes which, if adopted by the Legislature, will give effect to the system which they recommend. What they propose is the creation of a Department of Education, including both the University and the Department of Public Instruction, of which a single officer, known as the Chancellor of the University, shall be the responsible executive and administrative head. The University is, of course, continued, and has its oversight extended to cover the entire field of education, so that its real authority and opportunity for public service will be much increased.

The plan proposed is simple, effective, and wholly free from political or partisan considerations. It deserves the cordial support of all friends of public education, and this means of every patriotic citizen of the State.

It is impossible to exaggerate the importance of the interests involved, or the importance of considering them solely from the point of view of the general welfare of the State.

INDIAN UNIVERSITY FOR RESEARCH.

Consul Fee writes from Bombay under the date of November 1, 1899, to the Department of State as follows:

The conference which has been sitting at Simla, the hot-weather capital of India, considering the scheme for a research institute, has about completed its labor. Its recommendations will be submitted to the government of India for sanction, and later will be put into legal being by proper legislation.

The inception of the idea of this institution is Mr. Tata's, a wealthy resident of Bombay, whose public spirit and munificence has made its creation possible.

It is to be named the 'Indian University of Research.' It will be unlike all other universities of India, in that it will neither be an examining body nor bestow degrees, but will grant fellowship to distinguished students and graduates, and afford them facilities for research and investigation in the broadest sense possible. It will have a university court, consisting of a chancellor, a vice-chancellor, one member to represent the supreme government of India, one to represent each of the eight local governments, one for each of the five existing Indian universities, one to represent Mr. Tata, and one to be added for any benefactor who may subscribe not less than 15,000 rupees.

The site, the question of which gave rise to no little discussion, was finally granted to Bombay, with Bangalore, the chief city of the native state of Mysore, as a second choice. The fact that the Mysore government had offered to donate a site and a handsome contribution to the building may have been an attraction.

It is recommended that this new university coöperate with existing institutions by giving assistance to original scientific research where this work is now in any way hampered or curtailed.

The conception of this institution is as broad as its ultimate development will be vast. It will give a livelier tone to higher education in India, and be a noble monument to its founders and promoters.

SCIENTIFIC NOTES AND NEWS.

Mr. J. B. Hatcher has been appointed chief of the department of vertebrate paleontology of the Carnegie Museum, in place of Dr. Wortman, who has resigned. Dr. Wortman will undertake work on the collections made by the late Professor Marsh for the Peabody Museum, Yale University.

Sir Robert Ball, F.R.S., was elected president of the Mathematical Association for the ensuing year at the annual meeting of the Association at University College, London, on January 27th.

The Prince Regent of Bavaria has conferred the order of St. Michael on Dr. Nansen.

The address at the commencement exercises

of the University of Michigan next June will be delivered by John M. Coulter, Ph.D., head professor of botany in the University of Chicago.

DR. GEORGE F. BECKER, of the Geological Survey, who was recently sent by the government to the Philippines to report on the geology and mineral resources of the islands, has returned to Washington.

THE death is announced in Berlin of Dr. W. Hauchecorne, director of the School of Mines.

WE also note with regret the death, on January 13th, of Dr. J. W. Gunnings, professor of chemistry at Amsterdam, at the age of 72 years; of Dr. Peter Waage, professor of chemistry at Christiana, at the age of 57 years, and of General Alexis de Tillo, of St. Petersburg, known for his work in geography and meteorology.

THE mineralogical museum of Columbia University will be named after the late Thomas Eggleston, long professor of mineralogy and metallurgy at the University, to whose gifts and efforts the museum is chiefly due.

PROFESSOR G. H. PARKER, on January 29th, lectured before the New York Academy of Sciences, under the auspices of the Section of Biology. The title of the lecture was 'The Neurone Theory in the Light of recent Discoveries.' The lecturer gave a summary of the development of our knowledge of the histological structure of the nervous system, and contrasted with the neurone theory as widely understood that of Apathy's, which declares the absolute continuity of the nervous system by means of the fibrillæ in the nerve cells and fibers as demonstrated by his method of technique. The lecture was closed by a criticism of Apathy's interpretation of his preparations.

DR. EDWARD THORNDIKE, of Columbia University, gave a series of five lectures before the course in General Biology at the University of Chicago, February 4th to 9th. One of these was also open to all members of the University.

PROFESSOR T. H. MORGAN, of Bryn Mawr College, will repeat the course of lectures given at Columbia University at the University of Chicago, February 19th to 23d.

ON February 8th, Professor H. H. Turner, F.R.S., Savilian professor of astronomy in the University of Oxford, gave the first of a course of three lectures at the Royal Institution on 'Modern Astronomy.' On March 22d, Mr. H. J. Mackinder will deliver the first of a course of three lectures on 'Equatorial East Africa and Mount Kenya,' in the place of Mr. E. A. Fitzgerald, who is unable to deliver his course of lectures owing to his departure for South Africa.

LARGELY through the generosity of Mr. W. F. E. Gurley, formerly State Geologist of Illinois, the University of Chicago has come into the possession of an exceptionally valuable collection of paleozoic fossils. The making of this collection has been the life work of Mr. Gurley and it is undoubtedly the best existing collection of the paleozoic fossils of the interior States. It also contains a large amount of excellent material from other regions. The collection is estimated to contain 15,000 species, and several hundred thousand specimens. With this collection as a nucleus, the University of Chicago will be in position to build up one of the most valuable collections of paleozoic fossils in America.

MR. MORRIS STEINERT has given to Yale University his collection of historical musical instruments. It includes more than 500 pieces, including some of great value, representing the development of the piano and violin. The collection also includes musical manuscripts and original musical compositions.

BY the will of Mme. Beaucourt the Geological Society of France receives 40,000 fr., the income of which is to be used for research work.

IT is stated in the *Scientific American* that the sum of $7,550 has been given by Professors Haeckel, Conrad and Fraas, to be awarded for the best essays submitted on the application of the Darwinian theory to international political development and legislation. The essays must all be submitted prior to December, 1902.

THE American Section of the International Association for Testing Materials, of which Professor Mansfield Merriman, of Lehigh University, is chairman, has received contributions to its publication and research fund amounting to $655.

WE learn from the *National Geographic Magazine* that the French government will erect a

meteorological observatory on a hill near Tonkin.

THE Weather Bureau proposes to extend its service by establishing stations at all the Mexican Gulf ports between Tampico and Progreso.

A TELEGRAM has been received at the Harvard College Observatory from Professor Kreutz, at Kiel Observatory, stating that Comet *a* 1900 (Giacobini), was observed by Javelle at Nice, February $3^d.2893$, Greenwich Mean Time, in R. A. $2°\ 49'51.''0$, and Dec. $-6°\ 40'\ 10''$:

Daily motion in R. A. $-39'$
" " " Dec. $+25''$

A CABLEGRAM to the daily papers reports that there were 400 deaths at Bombay on February 5th, more than on any day since the first outbreak of the plague.

THE congregation of the University of Chicago, at its meeting on January 3d, adopted a resolution to the effect that the official publications and journals of the University should use the simplified spelling recommended by the National Educational Association. This action was, however, overruled by a vote of 20 to 16 by the Faculty Senate.

ACCORDING to the daily press, the cable sounding ship *Nero* which arrived at Honolulu on January 29th, while between Guam and Manila, made the deepest ocean soundings that have yet been recorded. She found a large area over which the soundings showed 5260 fathoms, about 260 fathoms more than had ever been found before. This area was named Nero's Hole.

THE second annual meeting of the New England Association of Chemistry Teachers was held at the United States Hotel, Boston, on February 3d. Mr. Charles A. Pitkin, of South Braintree, reported for the committee on physiological chemistry, and Mr. Irving O. Palmer, of Newton, for the committee on new apparatus and methods, while Professor Theodore W. Richards, of Harvard University, told of Harvard requirements for admission in chemistry. Mr. Rufus P. Williams, of Boston, was elected president, and Mr. H. J. Chase, of Newton, secretary, for the coming year.

THE *Electrical World* states that the English army surgeons' employment of the Röntgen rays in field surgery has proved most successful, and has met with the highest commendation. Orders have been received for a fresh equipment and skilled operators, and before February it is likely that every column at the front will be furnished with a Röntgen ray outfit. Wireless telegraphy is also rapidly gaining ground. Marconi outfits are being installed on three British vessels destined for active service, as well as on the passenger steamers in the English Channel.

AT a New York State Civil Service Examination to be held on February 24th, the position of assistant in geology in the State Museum, will be filled. The salary of this office is $900. It is desired that candidates shall be graduates in civil or mining engineering.

A VACANCY exists among the second-class assistantships in the Geological Department of the British Museum, owing to the removal of Professor Gregory to Melbourne. Admission to these posts is by Civil Service examination in general and special subjects, after nomination by the trustees. The maximum limit of age has recently been lowered to 25 years. The British Treasury Department has, however, the power of appointing persons over this age and without examination, should a strong recommendation to that effect be made by the trustees. It is said, however, that such appointments have always been highly unpopular with the working staff.

ACCORDING to the bill now before Congress, providing for a Department of Commerce with a Cabinet officer, the Patent Office is removed from the Interior Department and placed under the proposed Department of Commerce.

A BILL has been introduced into the New York Legislature appropriating $200,000 for the construction and equipment of suitable buildings for carrying on the work of promoting knowledge throughout the State in forestry and agricultural lines by Cornell University.

THE president of the British Board of Agriculture has appointed a departmental committee to inquire and report as to what regulations may with advantage be made by the

Board of Agriculture, for determining what deficiency in the normal constituents of genuine milk or cream, or what addition of extraneous matter or proportion of water, in any sample of milk (including condensed milk), or cream shall raise a presumption that the milk or cream is not genuine. The committee will consist of the following gentlemen: Lord Wenlock, (chairman), Mr. George Barham, Mr. George Cowan, Major Patrick George Craigie (an assistant secretary of the Board of Agriculture), Mr. S. W. Farmer, Mr. Shirley F. Murphy, M.D., Professor Thorpe, F.R S. (principal chemist of the Government Laboratories), and Mr. J. Agustus Voelcker, Ph.D. Mr. Robert Henry Rew, of the Board of Agriculture, will act as secretary to the committee.

AN effort is being made by the New York Fish, Game and Forest League in New York State to secure the establishment of a State Biological Station. Professor H. A. Surface, chairman of the biological committee, writes that its purpose would be the making of investigations and practical experiments (*a*) to determine the nature, habits, food, and needs of the fish, game and insectivorous and song birds; (*b*) to determine the causes of their decrease; (*c*) to determine what measures can be taken to reduce their enemies, increase their natural food supply and shelter, and secure such natural or modified conditions as should lead to their abundance throughout the State; (*d*) to propagate not only the desirable creatures named above, but also their natural food supply; (*e*) to study and experiment with the best methods of introducing beneficial species, to show what measures can be taken to help them to become acclimated, and to provide for their winter feeding and shelter; (*f*) to obtain material for publication; (*g*) to obtain facts upon which proper legislation can be based to secure the effective protection and maintenance of desirable species and the destruction of obnoxious kinds; (*h*) to obtain facts that may be useful to teachers of nature study, natural history, biology, botany, zoology, ornithology, ichthyology or forestry in the State. Another important feature will be the preparation and labeling of collections of specimens (especially fishes and other aquatic and semi-aquatic animals) for schools of the State, which will stimulate scientific research and facilitate better methods of science teaching.

A MARINE laboratory and museum will be opened at the University of Berlin on the first of April.

A SECOND edition of the Botanists Directory, published by I. Dörfler, Vienna, is in preparation. The publisher will be glad to receive the names and addresses of all botanists, especially those whose names do not appear in the first edition, as well as information concerning botanical gardens and societies concerned with botany.

WE learn from the *London Times* that the report by Sir William Crookes, F.R.S., and Professor Dewar, F.R.S., on the composition and quality of daily samples of the water supplied to London for the month ending December 31, 1899, states that of the 192 samples examined by them during the month, all were found to be clear, bright, and well filtered. The rainfall at Oxford during the month was 1.30 in. The average for the past 30 years is 2.10 in.; this leaves a deficiency of 0.80 in., bringing the total deficiency for the year up to 4.54 in., or 17.6 per cent. The general supply has been admirable from a bacteriological point of view. During the year they examined 4792 samples of London water bacteriologically, as compared with 3590 and 3249 respectively in the two previous years. They also made 2456 chemical analyses of London waters, making a total of 7248 samples examined. During the first six months the Thames-derived companies clear-water wells contained on the average 32 bacteria per cc., while the New River and River Lea supplies contained respectively 18 and 25. During the second six months the number of bacteria in the waters from the three were respectively 22, 12, and 14. These results show that during the year effective filtration of the London waters has been properly maintained. The report adds: "When we consider that a water containing about 100 bacteria per cc. in the clear-water wells would be regarded by the highest authorities as properly filtered, we see that the London supply must be considered exceptionally good."

THE *British Medical Journal* states that

there are now eight Pasteur Institutes in France; arranged according to the dates of their establishment, they are those of Paris, Algiers, Tunis, Montpellier, Marseilles, Bordeaux, Lille, Lyons. The last was opened on the first day of this year. There are five like institutes in Italy (Bologna, Milan, Naples, Palermo, Turin), two in Austria-Hungary (Vienna and Buda-Pesth), seven in Russia (St. Petersburg, Moscow, Samara, Kharkof, Warsaw, Odessa, Tiflis), two in the Ottoman Empire (Constantinople, Aleppo), one in Roumania (Bucharest), and one in Malta.

'Variations and Regeneration in Synapta inhaerus' on page 178 of the number of Science for February 2, 1900, should have the name of the author, Professor Charles L. Edwards, attached to it.

UNIVERSITY AND EDUCATIONAL NEWS.

Plans for a botanical laboratory to cost over $100,000 have been submitted to the Senate of Cambridge University.

The new wing of the engineering laboratory at Cambridge University, erected in memory of the late Dr. John Hopkinson by his widow and family, was formally opened on February 2d by Lord Kelvin; and at the same time a portrait of Dr. Hopkinson was unveiled.

St. Lawrence University has recently received a gift of $24,000 from a friend of that institution.

The Massachusetts Institute of Technology offers a new course in landscape architecture which, as provisionally laid out, includes in the second year horticulture, elementary architectural design, shades and shadows, perspective, freehand drawing, surveying, topographical drawing and dynamical geology, with the usual general courses in physics, language and history. In the third year the same general lines of work will be followed, with work in horticulture at the Arnold Arboretum, architectural and landscape design, architectural history, freehand drawing and pen and ink, stadia and plane table surveying, curves and earth-work, highway engineering and structural geology. In the fourth year, landscape architecture and design and horticulture will be the main features, with courses in sanitary engineering and drainage, building stones and sanitary science, history of ornament, life class, modeling, pen and ink, water color, specifications and working drawings and business relations. An arrangement has been made with the director, Prof. C. S. Sargent, of the Arnold Arboretum, by which students will receive a part of their instruction there, particularly in all that relates to planting and the use of plants and trees. With this work at the Arboretum will be combined a series of excursions to neighboring parks and country places in order to study examples of planting and design. The special instruction in landscape design will be conducted by Mr. Guy Lowell a graduate in the class of 1894, who has since taken the diploma of the École des Beaux Arts with distinction, and has made a special study of landscape architecture in Europe.

The course of landscape architecture, at Harvard University, the establishment of which we recently announced, has been placed under the direction of Mr. Frederic Law Olmsted, Jr. He will be assisted by Mr. Arthur A. Shurtleff.

The Techincal Education Board of the London County Council offers two scholarships of £150 each to teachers in schools. They are tenable from Easter to Christmas 1900, and enable the holder to visit the continent and study methods of teaching modern languages in commercial schools.

The foundation of a chair of American Archæology at the University of Berlin by the Duke of Loubat, has given a great impetus to the development of the teaching of anthropology at that University. Recently it has been announced that Adolf Bastian has been made Professor Ordinarius of Ethnology. This has been followed by the announcement of the appointment of Dr. Felix von Luschan as Professor (extraordinarius) of Anthropology.

Nichols Knight, Ph.D., of Syracuse University, has been appointed professor of chemistry at Cornell College, Mt. Vernon, Ia.

June E. Downey, A.M. (Chicago), has been appointed instructor in psychology at the University of Wyoming.